WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL

→ *Flocculators of New Moores Bridges Water Plant*

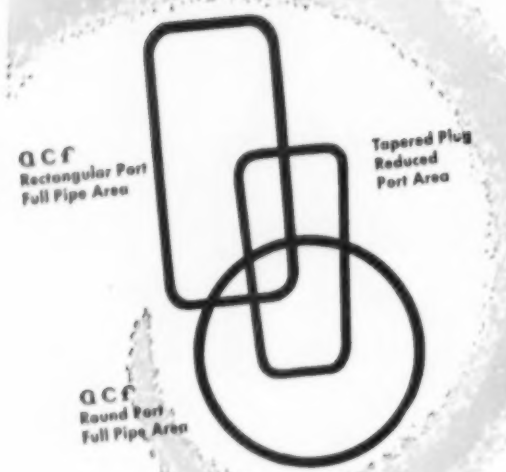
See Water Treatment at Norfolk, Va.—Page 415

Seymour Solves Difficult Waste Treatment Problem

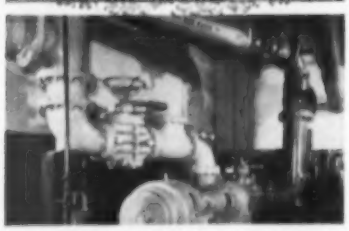
Sewer Service Charges Based on Metered Water Use

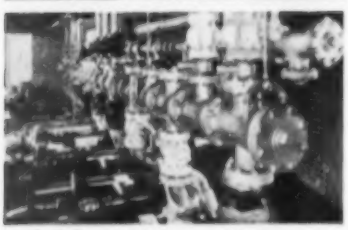
OCTOBER 1955

BEFORE YOU BUY ANOTHER PLUG VALVE...



COMPARE THE PORT OPENINGS!





acf Plug Valves are backed up by Proof-of-Performance in every Processing Industry!

Turbulence! Loss of head pressure! These can present real problems when handling slurries and other viscous liquids! And because they are ordinarily the result of valves with "funnel action"... it pays you to make sure that the port opening has the same area as the pipe itself!

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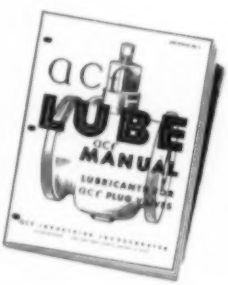

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WATER AND SEWAGE WORKS is published monthly with an extra issue in June. Subscriptions including the Reference and Data issue in the U. S. and Canada, 1 year $3.00; 2 years $4.50; 3 years $6.00. Other countries $1.50 per year additional. Single copies 25¢ except Reference and Data issue 50¢.

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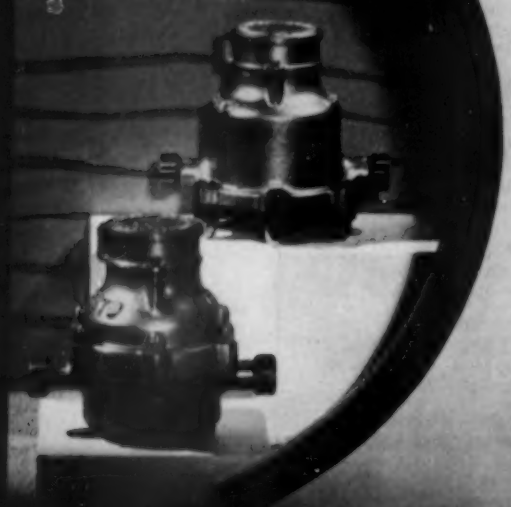
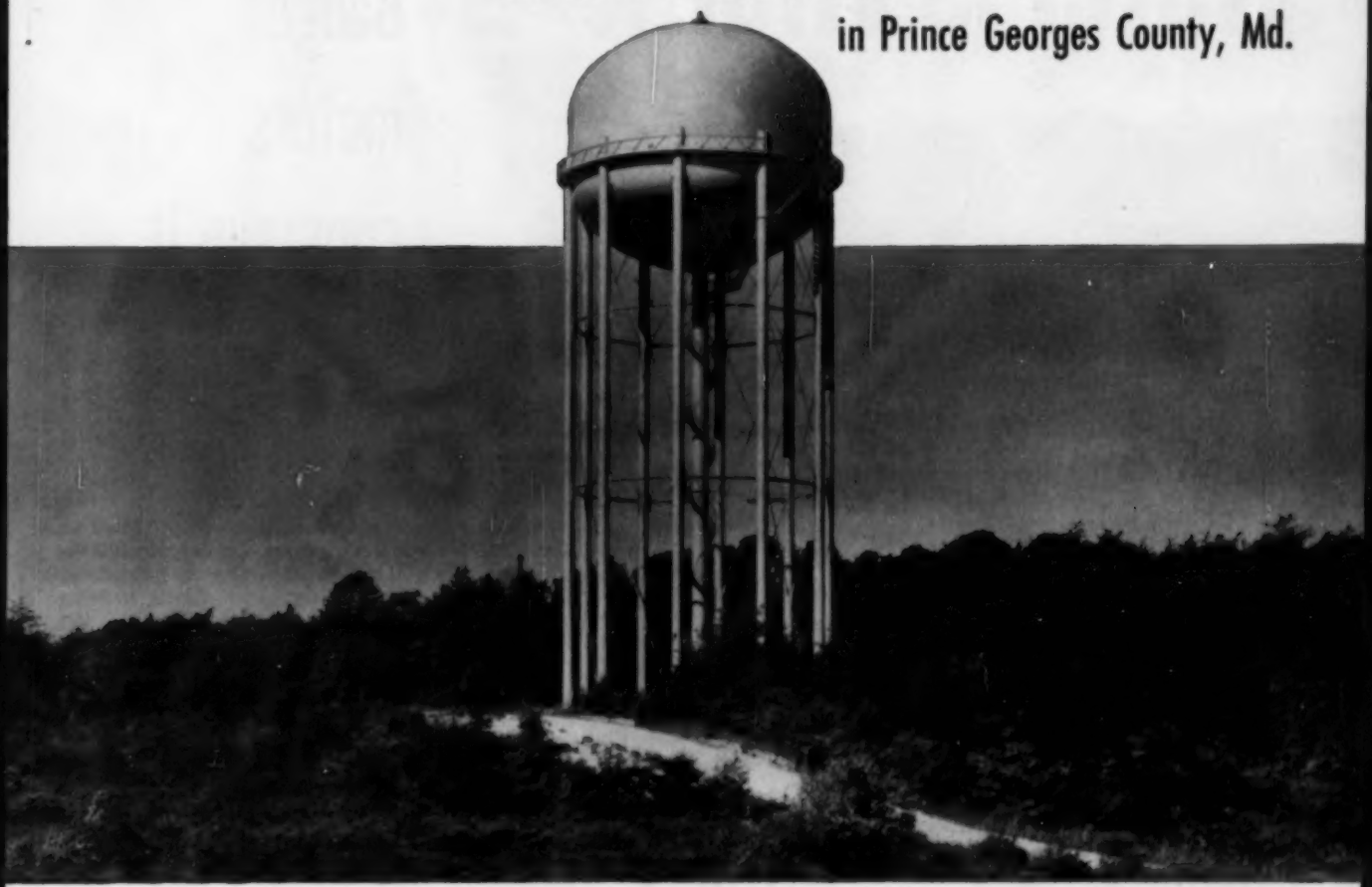


Water rides on a tall tower for better consumer service in Prince Georges County, Md.



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A million gallons of water, 160 ft high in this P-DM elevated steel tank, "rides" on the Washington Suburban Sanitary Commission system at a location distant from the source of supply. A relatively high head range of 47 ft accommodates the variations in supply pressure, so that water may always accumulate during off-peak hours and be available to augment the supply at peak demand periods. Diameter of the tank is 65 ft. • A broad picture of the many Pittsburgh-Des Moines Elevated Steel Tank types is provided in our illustrated 20-page brochure. Write for your free copy.

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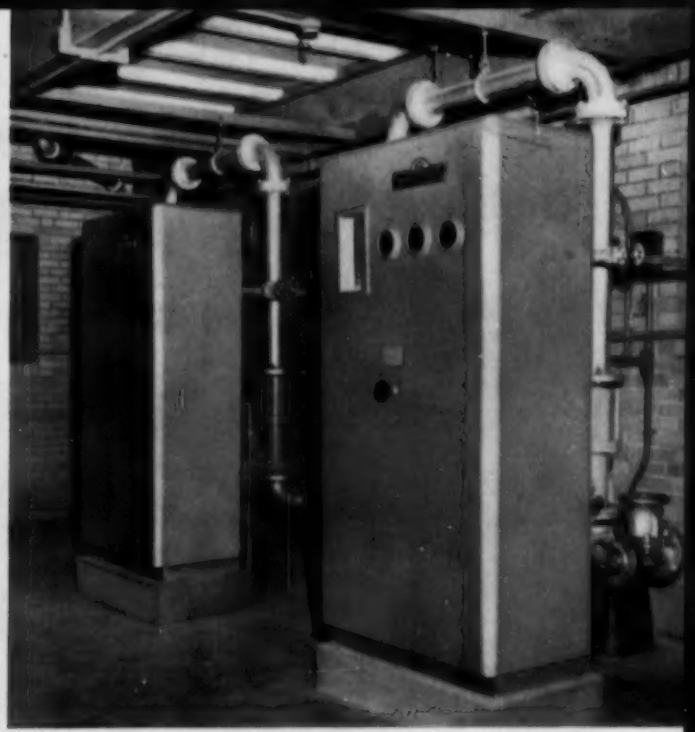
One of the two temporary chlorinating stations which served the Blackstone Valley Sewer District during the interim disinfection period. One of the Builders Chlorinizers can be seen in the background.



Builders Model HCVS Chlorinizers as finally installed in the Bucklin Point Sewage Treatment Plant in East Providence, R. I. Control can be automatic and proportional to flows of the plant influent flumes.

CHLORINIZER'S super-wide range pays dividends at Bucklin Point Sewage Plant

Two Builders Chlorinizers were placed in service by the Blackstone Valley Sewer District Commission over a year and a half prior to the completion of their Bucklin Point Sewage Treatment Plant at East Providence, R. I. These Chlorinizers — Model HCVS — were factory-equipped for super-wide range feeding . . . from 100 to 6000 lbs. of chlorine per 24 hrs. without changing orifices or meter scales. An interim disinfection program was instituted which took care of all sewage and wastes flows collected by the new interceptor system RIGHT FROM ITS FIRST STAGES — and charges could be levied against industries and municipalities as they tied in. Later, these same Chlorinizers were installed in the finished plant where they are now serving. Blackstone Valley Sewer District Commission reports the Chlorinizers have given completely satisfactory service both during the interim period and now that the plant is in full operation.

Find out why the trend is to Chlorinizer . . . for replacement, for plant expansion, for new projects. Write today for Bulletins to Builders-Providence, Inc., 350 Harris Avenue, Providence 1, Rhode Island.

CLARENCE V. HICKEY, OPERATING ENGINEER, SAYS:
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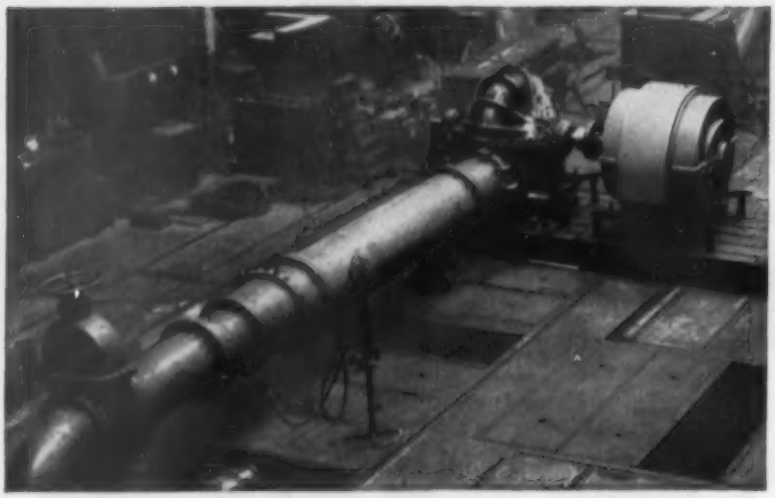

We have a lot of experience at Worthington—more than 114 years of it—and we're picking up more all the time.

But technology advances every day. Each step forward brings with it new and unsolved pumping problems. That's why Worthington's research and development program is continuous. That's also why we like to work with you during planning to get the jump on problems before they reach the costly stage.

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For your day-to-day pumping problems, our sales engineers are thoroughly trained in pump applications in every field, and can usually supply the right answer fast. Naturally, for the really tough ones, our staff engineers back them up with all the equipment and facilities of our shops and laboratory. In addition, factory-trained troubleshooters are available to cope with any problem that may arise in the field.

From cat-cracker to atom-cracker

Our specialists, covering all major industries, work as a team. Together, they bring to bear on any problem a vast store of experience. They've successfully solved pumping problems and helped pioneer new developments in public works, atomic energy applications, the oil industry, and the chemical industry—to name a few.

So keep your eye on Worthington; we probably have a money-saving answer to your pumping problems. C-51

TEST STAND CAPACITY UP TO 100,000 GPM is provided at Worthington's Harrison plant *(above)*. Built over a man-made half-acre lake, the test stand is used as a production tool to check pumps from fractional horsepower up. This flexibility comes in handy—in one line alone Worthington can put together 60,000 different standard pumps out of 650 parts in six standardized sets of liquid ends.

DIRECTING PUMP TEST OPERATIONS from central control room *(left)* where special measuring instruments speed collection of performance data. Worthington pump specialists can afford to be objective in considering your pump application problem. They select from the most complete line of pumps offered by any manufacturer.

WORLD'S FIRST ATOMIC-POWERED SUBMARINE, *NAUTILUS*, undergoing sea trials. In atomic development since 1941, Worthington recently built special engine room equipment for both atomic submarines, *Nautilus* and *Sea Wolf*. Worthington continues to figure prominently in supplying this new field of atomic energy, keeping pace with its new and rapidly changing requirements.

EUTECTIC CASTING, used in making standard Worthington pumps, frees engineer from casting restrictions. Formerly, design of impeller and diffuser blades had to allow hand withdrawal from fragile sand core. Eutectic casting uses a low-melting-point alloy to form blades, melting this alloy out during baking. This permits design flexibility for maximum hydraulic performance.

VITALITY OF WORTHINGTON RESEARCH PROGRAM is shown by the more than 300 articles in the technical press during the past five years by Worthington people. This flood of informative technical literature not only reflects our ability to keep pace with the changing hydraulic requirements for modern pumps, but also highlights the important contributions by Worthington to the knowledge of pumps.

HANDLING 11,000,000 GALLONS PER DAY, the new sewage plant at Salem, Oregon, has Worthington pumps for continuous, economical pumping power. John W. Cunningham & Associates, Portland, Oregon, were the Consulting Engineers for this project.

Salem's sewage system relies on these pumps

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Helping municipalities with their sewage and water works problems is our job today — has been for over 100 years. Write today for Bulletin W-317-B16 to Worthington Corporation, Public Works Division, Harrison, New Jersey. W.4.11

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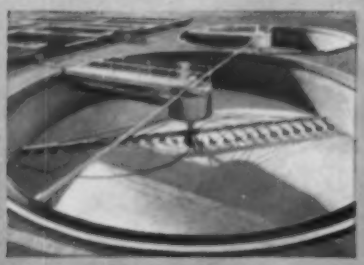

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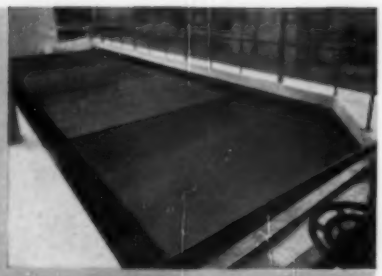

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Introduction of the Rex Verti-Flo® Clarifier made possible improved settling . . . increased capacities . . . important cost savings.

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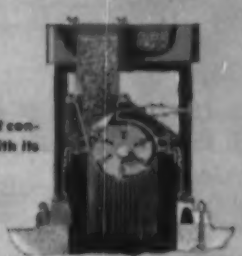

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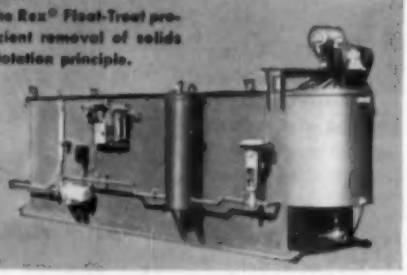

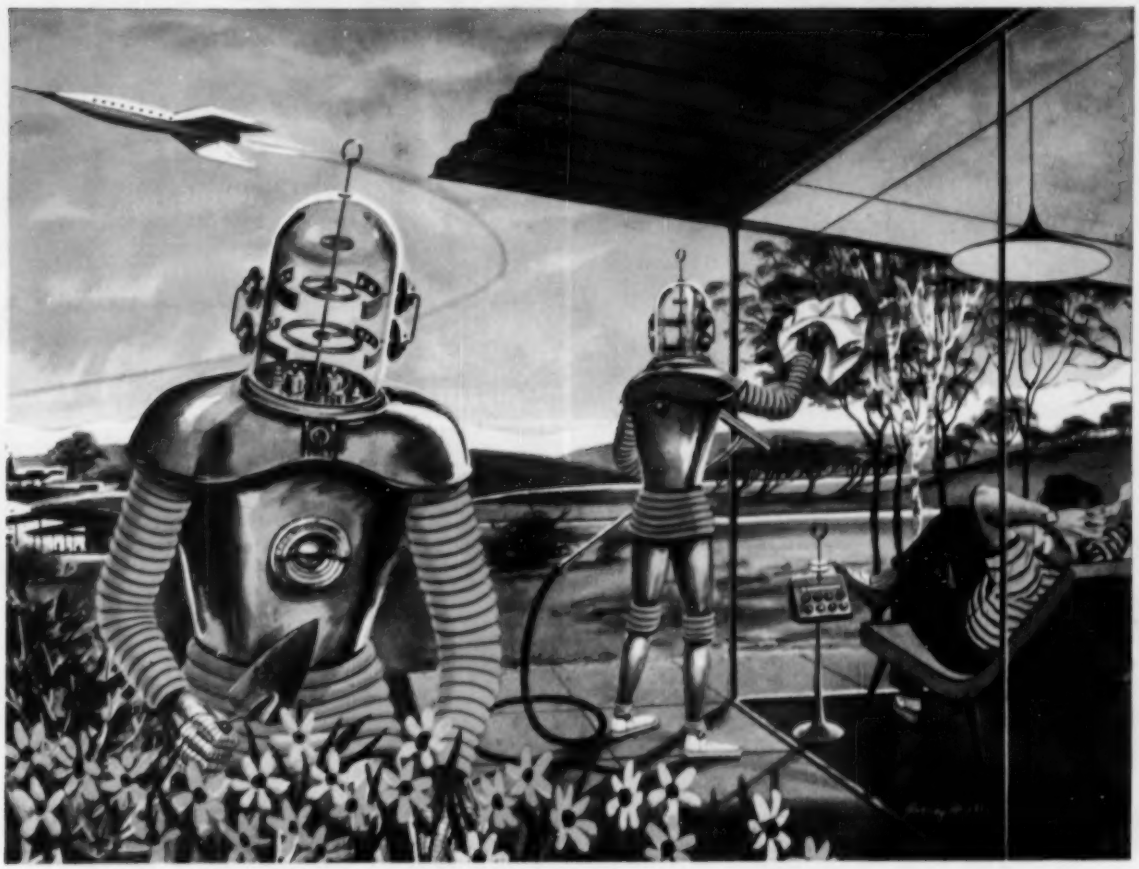

COMPETENT, BLOODLESS WORKERS . . . tireless, economical . . . electronically controlled and directed. These, science predicts, may be our "servants" of the future.

100 years from now...

ROBOTS MAY DO OUR WORK

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Over 60 American cities and towns are still served by cast iron water and gas mains laid over a hundred years ago. And today, modernized cast iron pipe, centrifugally cast and quality controlled, is even stronger, tougher, more durable.

U.S. Pipe is proud to be one of the leaders in a forward-looking industry whose service to the world is measured in centuries.

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FOR WATER, GAS, SEWERAGE AND INDUSTRIAL SERVICE
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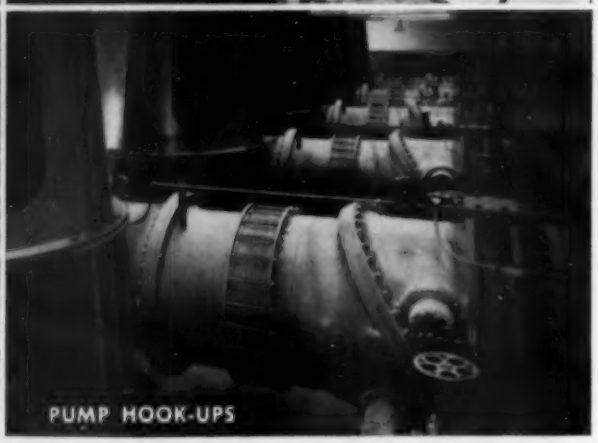
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For any sewerage pipe job . . .

DRESSER COUPLINGS make joining easier, surer!

Every sewerage job presents individual piping problems: cramped space, heavy vibration, tight deflections and so on.

That's why the versatility of Dresser Couplings is so important. Using this joining method, contractors can handle *any* job . . . hit estimates and completion dates on the nose . . . provide work that gives permanent satisfaction.

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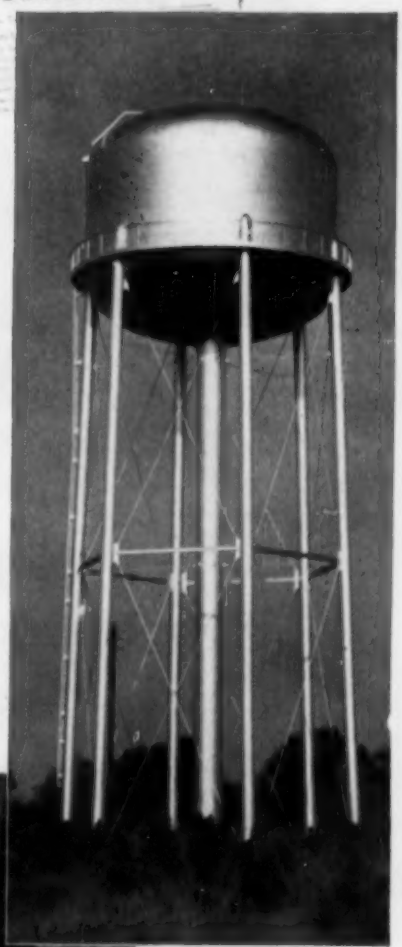
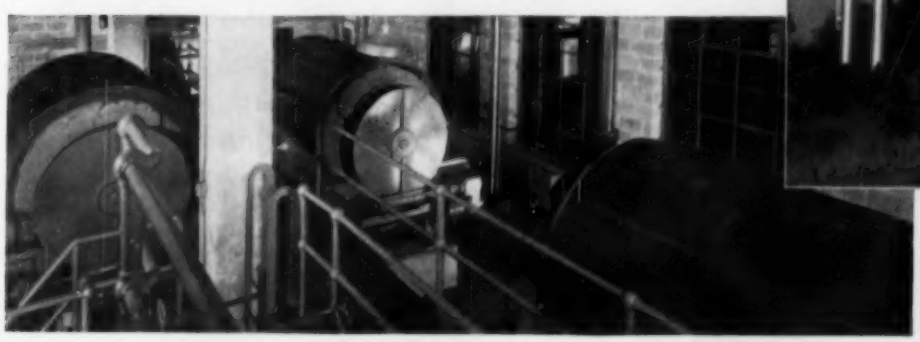
Over 2,000 tons of dry solids from sewage and industrial wastes are dewatered daily on Conkey Sludge Filters. From Maine to California, Horton® elevated tanks, in capacities to 3,000,000 gals., are providing a dependable gravity pressure water supply that is helping municipal water systems meet peak load periods and reduce pressure variations. These headliners are providing dependability, economy and trouble-free service in large and small municipalities. Write the nearest CB&I office for further information on Conkey Sludge Filters and Horton elevated tanks.



Shown above is a 200,000-gal. Horton ellipsoidal-bottom elevated water tank, 74 ft. 6 in. to bottom, installed for municipal water service at Center, Texas.



Shown above are typical Conkey Filters dewatering primary sludge.

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the upper stretches of rivers
where instinct tells it to lay its eggs.
After spawning the fish dies.

This cast iron water main is entering
its second century of economical service
to the citizens of Sacramento, California.

MODERNIZED cast iron

they in common...

THE SALMON AND CAST IRON PIPE... DEPENDABILITY!

Spawning salmon can be counted on to return to the rivers where they were born. CAST IRON PIPE can be depended upon, too... to give years of trouble-free service, often for centuries.

AND HERE'S THE PROOF: Listed below are some of the many water utilities still using cast iron pipe that was installed a century or more ago.

DEPARTMENT OF WATER AND WATER SUPPLY, City of Albany, New York
ALEXANDRIA WATER COMPANY, Alexandria, Virginia
BUREAU OF WATER, DEPT. OF PUBLIC WORKS, Baltimore, Maryland
PUBLIC WORKS DEPT., WATER DIVISION, Boston, Massachusetts
DEPARTMENT OF PUBLIC WORKS, DIVISION OF WATER, Buffalo, N. Y.
WATER WORKS DEPARTMENT, Chicago
COLUMBIA WATER COMPANY, Columbia, Pennsylvania
BOARD OF WATER COMMISSIONERS, Detroit, Michigan
CITY OF FREDERICK WATER DEPT., Frederick, Maryland
PUBLIC SERVICE COMMISSION, City of Halifax, N.S., Public Water Supply
WATER BUREAU OF THE METROPOLITAN DISTRICT, Hartford, Connecticut
MUNICIPAL WATER WORKS, Huntsville, Alabama
BUREAU OF WATER, Lancaster, Pennsylvania
CITY OF LYNCHBURG WATER DEPARTMENT, Lynchburg, Virginia
MOBILE WATER WORKS COMPANY, Mobile, Alabama
QUEBEC HYDRO-ELECTRIC COMMISSION, Montreal, Quebec
PUBLIC WORKS DEPT., WATER-WORKS & SEWERAGE DIV., Montreal, Quebec
PENNICHUCK WATER WORKS, Nashua, N. H.
WATERWORKS DEPARTMENT, City of Nashville, Tennessee
DEPT. OF WATER, GAS & ELECTRICITY, New York, New York
DEPT. OF PUBLIC WORKS, BUREAU OF WATER, Philadelphia, Pennsylvania
BUREAU OF WATER, DEPT. OF PUBLIC WORKS, Pittsburgh, Pennsylvania
POTTSVILLE WATER COMPANY, Pottsville, Pennsylvania
BUREAU OF WATER, Reading, Pennsylvania
DEPT. OF PUBLIC UTILITIES (WATER), Richmond, Virginia
DIVISION OF WATER & SEWERS, Sacramento, California
WATER & SEWERAGE DEPARTMENT, City of Saint John, N.B.
DEPT. OF PUBLIC UTILITIES, WATER DIVISION, St. Louis, Missouri
WATER DIVISION, DEPT. OF ENGINEERING, Syracuse, New York
DEPT. OF PUBLIC WORKS, Troy, New York
CITY OF UTICA, BOARD OF WATER SUPPLY, Utica, New York
CITY OF WHEELING WATER DEPT., Wheeling, West Virginia
WILMINGTON WATER DEPT., Wilmington, Delaware
WATER DEPARTMENT, City of Winchester, Virginia
WATER DEPARTMENT, City of Winston-Salem, North Carolina
YORK WATER COMPANY, York, Pennsylvania
WATER DEPARTMENT, City of Zanesville, Ohio

TODAY... modernized cast iron pipe, centrifugally cast, is even tougher, stronger, more uniform. *Where needed and specified,* it is centrifugally lined with cement mortar to assure sustained carrying capacity throughout its long years of service.

Cast iron pipe's record of performance... measured in centuries... make it the world's most dependable carrier of water.

Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 122 So. Michigan Avenue, Chicago 3, Ill.

CAST IRON ®

The Q-Check stencilled on pipe is the Registered Service Mark of the Cast Iron Pipe Research Association.

pipe FOR MODERN WATER WORKS

New HOMELITE Pump

Whispers While It Works

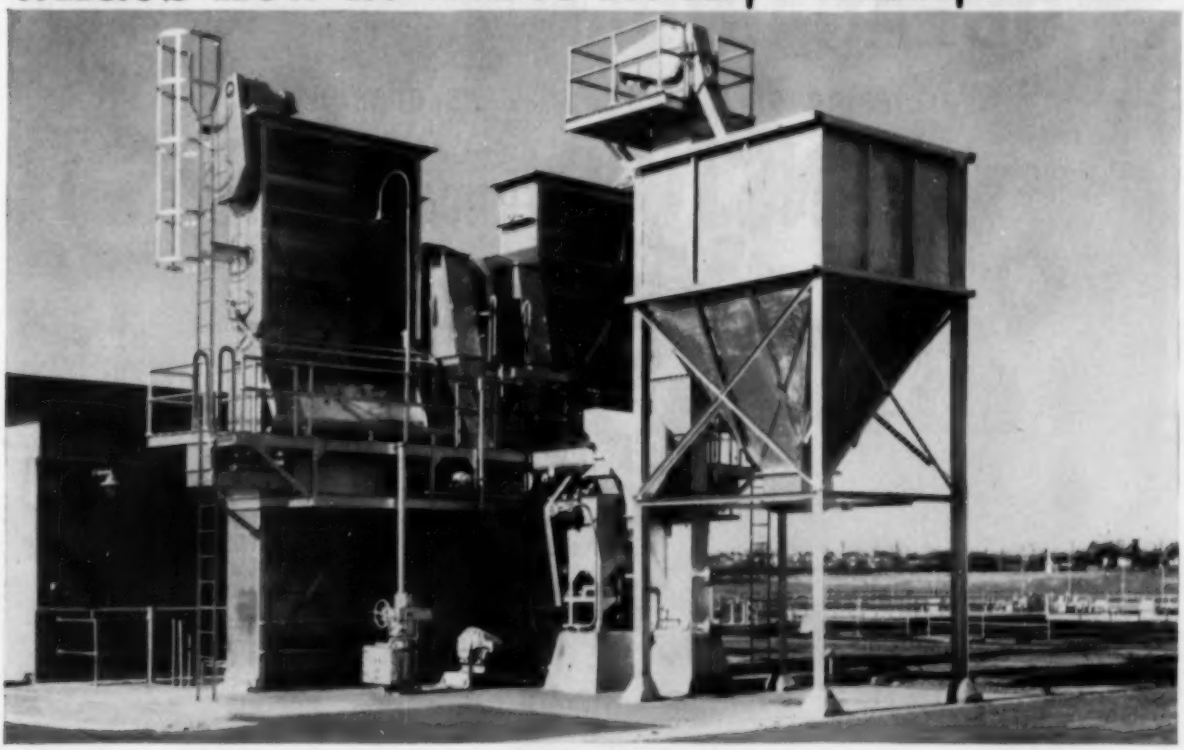
Goodby residential complaints! Here's a new lightweight gasoline engine driven pump that takes it easy on the neighbors' ears. Yet handles any water problem . . . from seepage to volumn pumping! The new Homelite Model 36 S2 2" self priming centrifugal Pump operates at slow speed with low noise level yet has high capacity of 9000 gallons per hour. It weighs only 85 pounds and can be easily carried by one man to the best pumping location. Starts quickly, primes automatically, gives long, dependable and trouble-free service under the toughest conditions. Ask your Homelite Representative for a free demonstration. You'll find a good neighbor policy in every pump.

HOMELITE CORPORATION

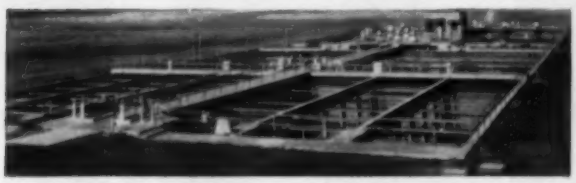
A Textron American Company

710 RIVERDALE AVENUE • PORT CHESTER, N. Y.

What's new at White Rock, Dallas, Texas?



1953 Two Jeffrey Grit Collectors, two Screens, a Grinder and Grit Washer.



1953 Sludge Collectors in primary and final tanks. Skimmers in primary tanks.

1952 Two Jeffrey Screens and two Jeffrey Grit Collectors.
1949 Two Jeffrey Screens and a Screenings Grinder.

1939 Sludge Collectors and Skimmers in primary tanks.

1939 Jeffrey Sludge Collectors in the final tanks.

Repeat Orders from long-time users of Jeffrey Sanitation Equipment are the best evidence of the high quality, durability and fine engineering design. For a copy of Catalog 833-A describing this equipment, write The Jeffrey Manufacturing Company, Columbus 16, Ohio.

JEFFREY

CONVEYING • PROCESSING • MINING EQUIPMENT
TRANSMISSION MACHINERY • CONTRACT MANUFACTURING

The World's Largest OCEANARIUM

"Marineland of the Pacific" uses dependable

JOHNSTON VERTICAL PUMPS

Two mammoth 4-story-high ocean tanks, thousands of live sea creatures living in natural surroundings — a center containing the fantasies of a nearly unknown world of undersea creatures — that is "Marineland of the Pacific" at Palos Verdes Peninsula, Los Angeles.

Two dependable Johnston Vertical Pumps furnish plenty of water to protect this tremendous living investment. Learn how Johnston Pumps can solve your pumping problems. *Write for folder, WSW-105*

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PUMP COMPANY

Bin "K," Pasadena 15, California

☐ Kindly send colorful, illustrated bulletin ☐ Have representative call

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Company_____

Address_____

City_____ State_____

now!... for the next 50 years

Measured as one continuous pipeline, AMERICAN'S output during its first fifty years would span the globe several times.

Measured in terms of service to people and to industry, AMERICAN products span the globe in a far more meaningful sense. AMERICAN cast iron pipe supplies water in millions of homes . . . strengthens fire protection . . . safeguards public health through sanitary sewer systems—all at significant dollar savings to the taxpayer.

Pipe, and centrifugally spun steel tubes manufactured by American Cast Iron Pipe Company, are serving the paper, chemical, steel, and hundreds of other industries. As precision parts in rockets, ships, and planes, AMERICAN products contribute to the strength of our nation's defense program.

On every continent AMERICAN products are filling hundreds of needs efficiently, economically, and permanently.

Having grown with the huge job that it does, AMERICAN today is one of the world's largest producers of cast iron pipe.

Now! . . . for the next fifty years!

50th ANNIVERSARY

AMERICAN

1905 1955

AMERICAN CAST IRON PIPE CO.

BIRMINGHAM 2, ALABAMA

SALES OFFICES

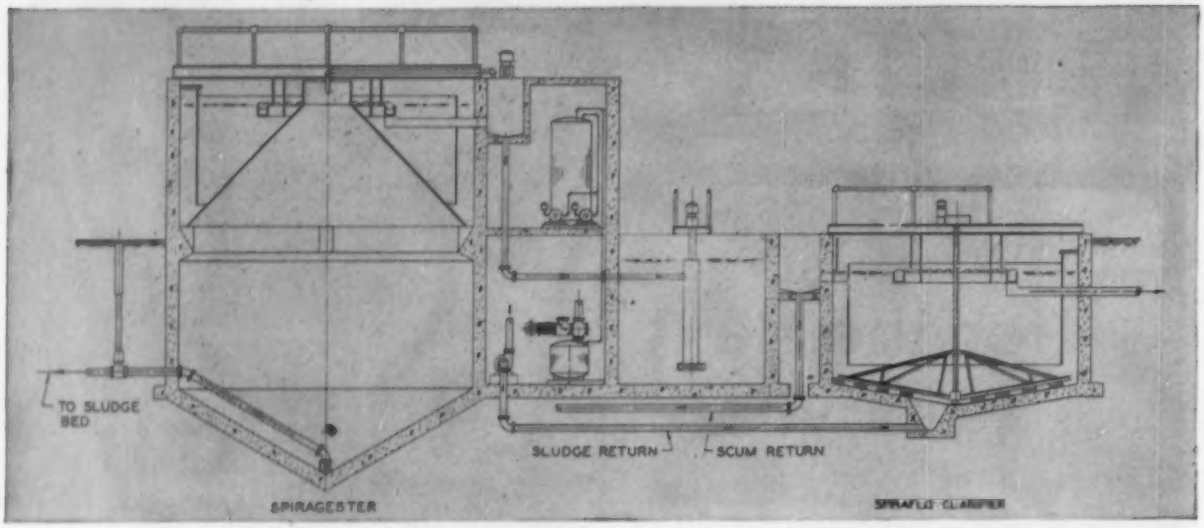
New York City, Chicago, Kansas City, Minneapolis, Dallas, Houston, Los Angeles, San Francisco, Pittsburgh, Cleveland, Seattle, Denver, Orlando

For the small activated sludge plant

YEOMANS presents

THE Cavitator* SYSTEM

For Municipal Waste Treatment



One of the many possible arrangements is illustrated. The secondary treatment is provided by the Cavitator mechanism, a specially designed rotor with two arms mounted on a hollow shaft through which air is drawn for dispersion through the tank contents. The arms are streamlined with the outer ends so constructed that when they are passed through the liquid at relatively high speeds they create a zone of cavitation through which the liquid is recirculated continuously. Air and liquid are drawn together creating a vapor pressure condition corresponding to cavitation with its tremendous forces. The oxygen is forced into the sewage and creates countless small air bubbles which permeate the entire liquid body.

One of four cavitators at New Holstein, Wis.

- **high oxygen transfer efficiency**—requires only 135 cu. ft. of air per lb. B.O.D. removal per day in the Cavitator system.
- **high performance on relatively low flows** with high B.O.D.
- **low installation and operating cost** with a high degree of purification.

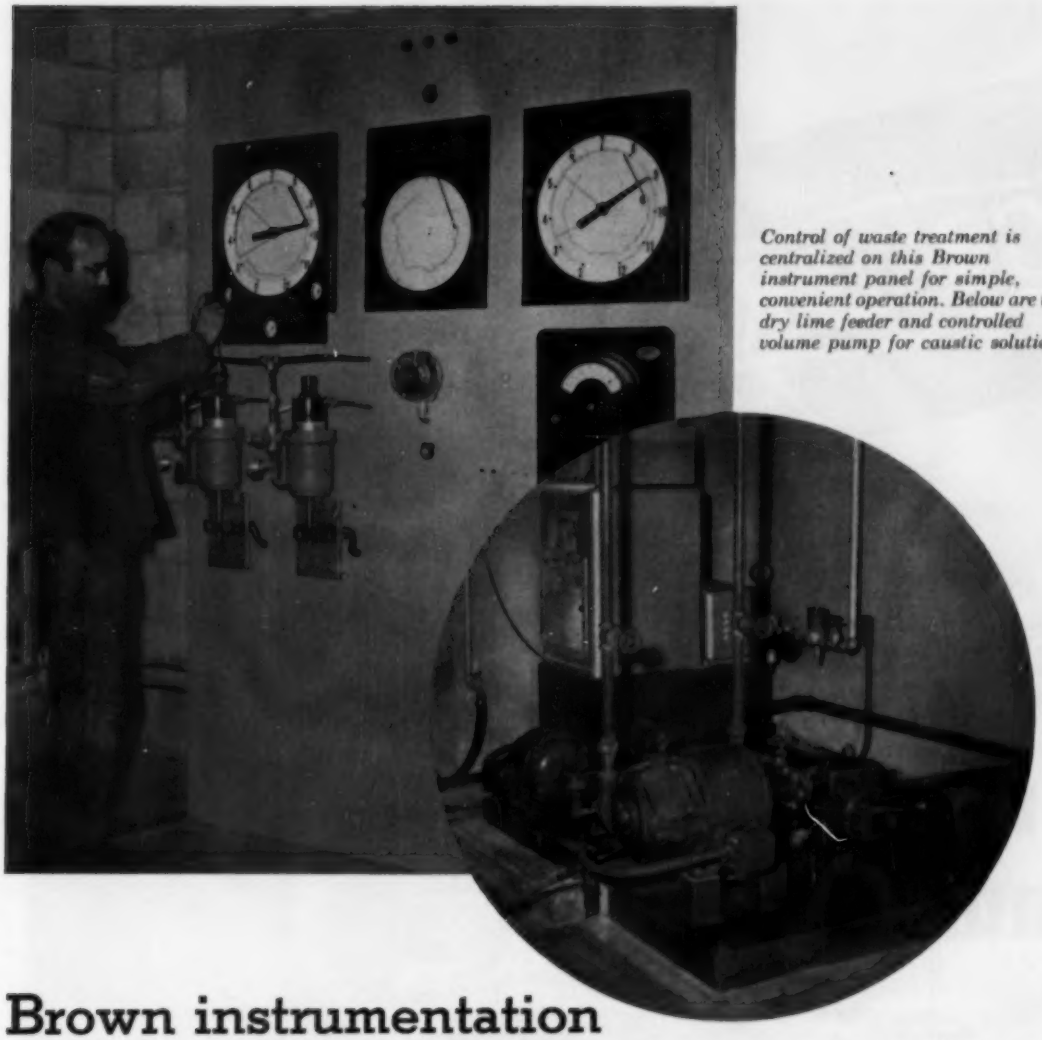
Primary clarification and digestion is accomplished in a single structure, the Spiragester. A Spiraflo is used for clarification.

Secure detailed information. See your local Yeomans representative listed in the Yellow Pages of your telephone book under "Pumps" or contact factory direct.

*A Yeomans Trade Name

Yeomans Brothers Company, 2000-2 N. Ruby Street, Melrose Park, Illinois

Manufacturers of: Distributors • Clarifiers • Digesters • Mechanical Aerators • Pneumatic Sewage Ejectors • Centrifugal Pumps



Control of waste treatment is centralized on this Brown instrument panel for simple, convenient operation. Below are the dry lime feeder and controlled volume pump for caustic solution.

Brown instrumentation *helps change plant waste to safe effluent*

Acid wastes from various metal-working operations are converted into neutral effluent, in the waste treatment facilities at General Electric's manufacturing plant at Allentown, Pa. Designed by Gilbert Associates, Inc. in cooperation with G.E.'s own water management and waste control engineers, the system features automatic control of reagent feed and continuous recording of operating data . . . by means of Brown instruments.

To bring wastes to the alkaline side, an *ElectroniK* pH recorder with pneumatic control regulates both a lime dry feeder and a variable volume pump for caustic solution. The proportional control system accurately adjusts reagent in relation to the amount of neutralization required . . . to assure both economical usage of chemicals, and complete safety of effluent.

Additional instrumentation provides a permanent, detailed record of overall system performance. A Brown flow meter, electrically connected to a float actuated transmitter at a weir some 100 feet from the panel, measures the flow of treated water discharged. A second *ElectroniK* pH recorder checks the final effluent.

For control of treatment process for industrial wastes, sanitary wastes and water supplies, Honeywell offers a comprehensive line of instrumentation . . . and a background of long engineering experience. Your local Honeywell sales engineer will be glad to discuss your specific project with you and your consulting engineer. Call him today . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

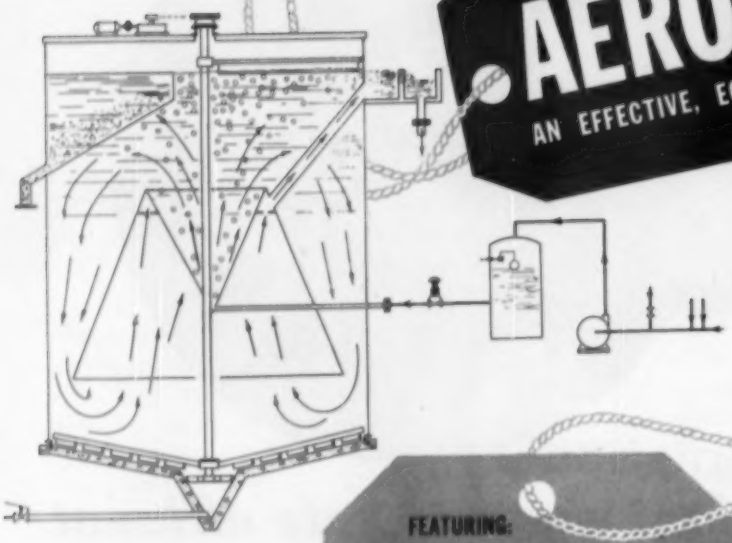
● **REFERENCE DATA:**
Write for Data Sheets No. 9.6-5a, "Dry Feed System"... No. 10.3-4a, "Float Actuated Meters"... and No. 11.12-1, "Automatic Sequence Control."

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls

GRAVER

AEROFLOTOR

AN EFFECTIVE, ECONOMICAL FLOTATION UNIT



FEATURING:

Optional sedimentation with sludge scraper

Automatic air release valve

Controlled "float" density

Minimum Maintenance

Compact Design

WRITE FOR BULLETIN WC-119

Industrial Waste Treatment Dept. W-114

GRAVER

GRAVER WATER CONDITIONING CO.

A Division of Graver Tank & Mfg. Co., Inc.

216 West 14th Street, New York 11, N. Y.

3300-TPA-2159

"X" MARKS THE OLD CONTROL HAZARDS THAT WERE eliminated at Council Bluffs: 1. Inadequate protection to electrical equipment. 2. Exposed disconnects. 3. Exposed wiring, unenclosed sides and rear. 4. Manual operation, subject to human fallibility. 5. Old style meters, too high and hard to read. All of these were *eliminated entirely* by the modern E-M HI-FUSE Control installation described at right.

Are there control hazards in your plant?

These are the questions which should be checked on regularly: How *safe* is the motor control system in your plant? How *reliable?* How *effective* in handling short circuits? How *capable* of meeting increased load requirements?

E-M engineers have made a specialty of solving problems such as these. For example, the E-M Magnetic HI-FUSE (High-Voltage, High-Interrupting Capacity) Control will give your plant a completely modern method of motor operation and protection. Shown above is a typical HI-FUSE Motor Control which replaced the old equipment at left in the Council Bluffs, Iowa Waterworks.

And this is how HI-FUSE eliminated the hazards marked "X" in the old picture:

1. HI-FUSE current-limiting power fuses provide short-circuit protection to motor, control and power system.
2. HI-FUSE has enclosed fuse disconnects, fully protected.
3. Nothing "hangs out" . . . no danger to unauthorized personnel with HI-FUSE modern enclosed cabinet design.
4. HI-FUSE operation is "push button" magnetic . . . accurate, convenient, reliable.
5. Modern HI-FUSE meters are placed at eye level, can be read quickly and easily.

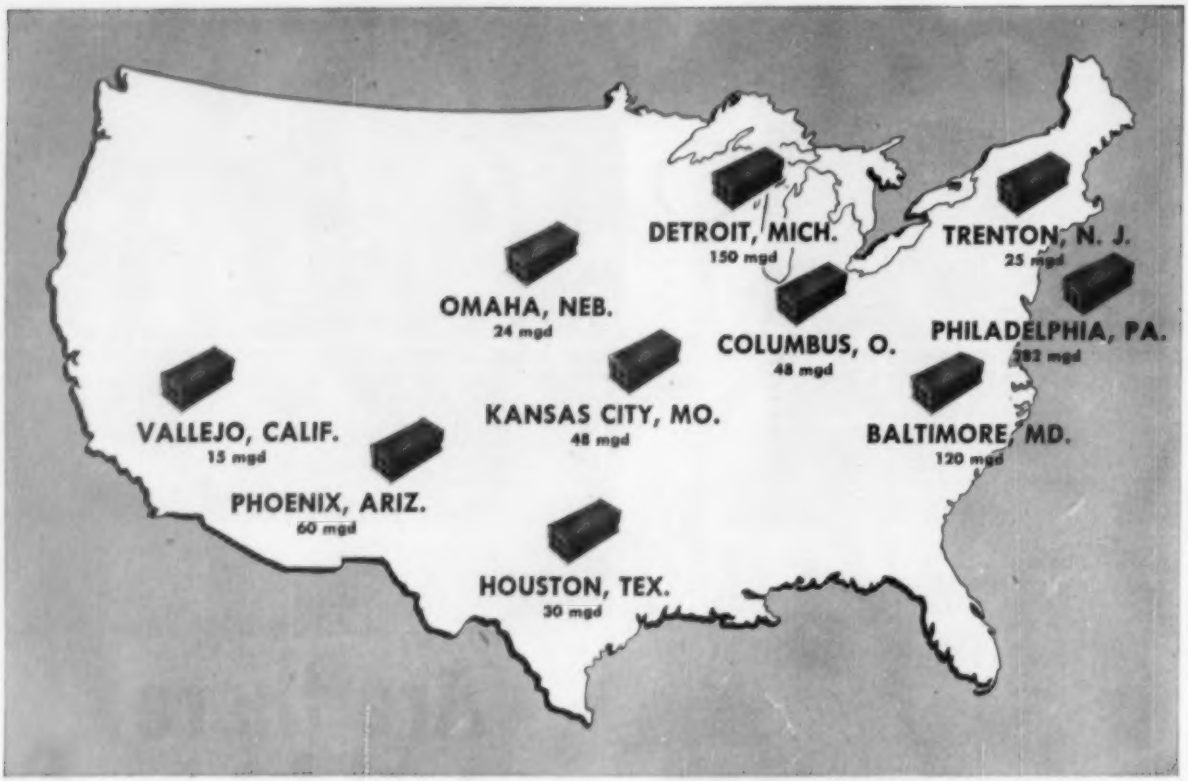
Installed in single units or in group line-up, E-M HI-FUSE Controls are pre-engineered, economical "packages" with a clean, sharp appearance. You can select oil switches or air-break contactors, as HI-FUSE offers both.

To see how this reliable control system will work in your plant, contact your nearest E-M sales engineer. Also, write for new *E-M Synchronizer No. 39*, "ABC of Large Motor Control".

Specialists in making controls do

EXACTLY WHAT YOU WANT THEM TO

ELECTRIC MACHINERY MFG. COMPANY
MINNEAPOLIS 13, MINNESOTA

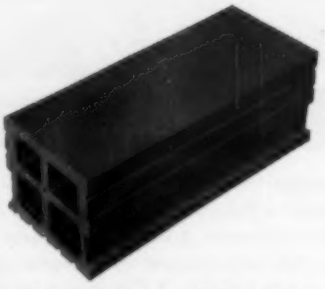


Ten more "top" filter plants select LEOPOLD Bottoms

Including these ten new major installations — six of which are still under construction — Leopold glazed tile filter bottoms are successfully serving well over 300 plants (with a daily capacity of 1¼ billion gallons). Every year Leopold bottoms are gaining in popularity — and for good reasons, too.

In this design, laterals and distributing blocks are combined in one permanent unit that insures equal distribution and uniform filtration. The individual blocks are made of de-aired fire clay, vitrified and salt glazed. They resist corrosion, are not subject to tuberculation, won't absorb any detrimental amount of water, are impervious to acids and alkalis, and will last indefinitely.

If you're looking for a practical, economical solution to your under-drain problems, consider the advantages offered by Leopold.



Each individual distribution block is about two square feet in area and weighs approximately 100 pounds.

Leopold

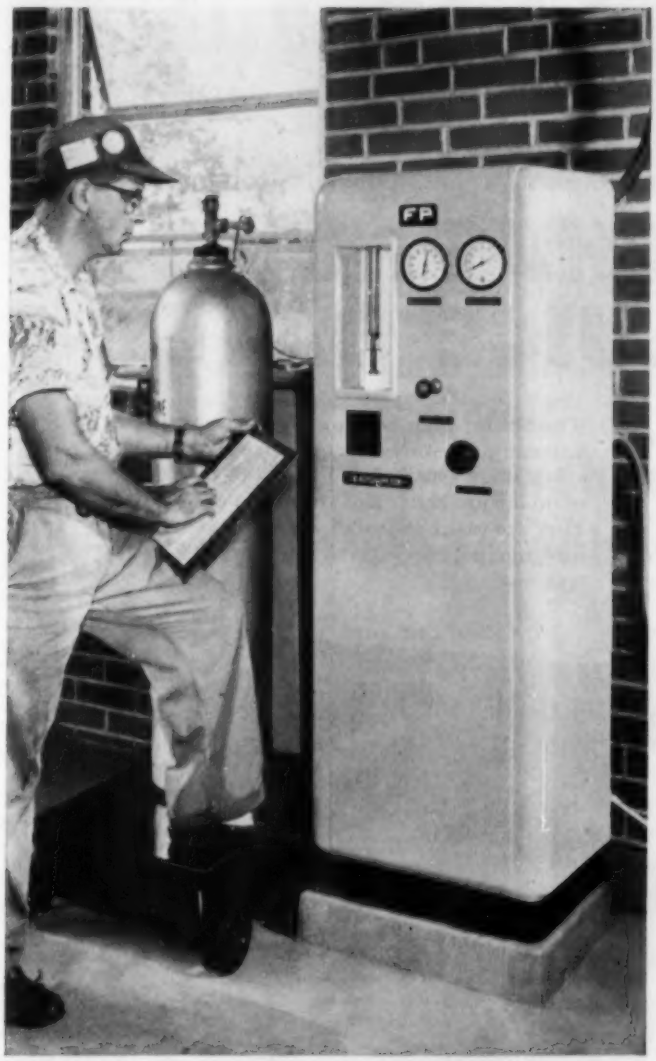
We'll be glad to supply details — without obligation

F. B. LEOPOLD CO., INC.
2413 W. CARSON STREET, PITTSBURGH 4, PA.

COMPLETE WATER PURIFICATION AND SEWAGE PLANT EQUIPMENT • DRY CHEMICAL FEEDERS
FILTER OPERATING TABLES • MIXER EQUIPMENT

FP *complete process instrumentation*

Ease of Operation & Low Cost Installation Sell Waterworks Official on F & P Chlorinator



Clarence Godshall, operator at the Lansdale Municipal Authority, taking readings of the chlorine flow rate.

The Lansdale (Pa.) Municipal Authority furnishes all the water for the Borough of Lansdale. Last year, the Authority provided 406,789,260 gallons from its artesian wells.

Recently faced with replacing several obsolete chlorinators, C. R. Ridington, superintendent of the Authority, specified a unit of standard parts and fittings. His only other requirement was that the chlorinator be simple enough in design to permit installation and maintenance by his own men. He found the answer in an F&P Chlorinator.

Let Mr. Ridington's own words show how satisfied he is. He says, "I am planning to install another F&P Chlorinator because of its low initial capital cost, ease of operation, and low maintenance."

These are the features of the F&P Figure 1050-A Chlorinator:

- Only corrosion-resistant materials are used
- Cabinet made of plastic-impregnated Fiberglas*—never needs painting
- Simplicity of operation—internal piping in vacuum system employs "snap-in" type construction with "O" rings requiring no unions
- Designed for installation by unskilled labor

Fischer & Porter offers a wide variety of chlorinators for use in municipal water and sewage systems, industrial plants, and swimming pools. Consult your local F&P representative or write for free literature.

*Trade Mark OCF Corp.

FISCHER & PORTER COMPANY

COUNTY LINE ROAD • HATBORO 15, PA.

Measuring, recording and controlling instruments
Centralized control systems
Data reduction and automation systems
Chlorination equipment
Industrial glass products

Sales offices in 32 American cities and in principal cities abroad

STOP High Installation Costs with—

CHAPMAN *Standard* SLUICE GATES

Whether for high head or low head, seating or unseating pressures, large or small waterway areas, there's a Chapman Standard Sluice Gate to do the job better and at lowest possible cost. They are easier to install and more economical to maintain for these three important cost-saving reasons.

1 ***Wide Selection*** — There are over 300 types and sizes of standard Chapman Sluice Gates to meet most conditions. Controls are for either manual, hydraulic or electric motor driven operation. Many special designs and sizes are also available.

2 ***Easy Installation*** — Chapman Standard Sluice Gates are faster and simpler to install because component parts are interchangeable. They fit perfectly, every time, without expensive and time consuming matchmaking or field alterations.

3 ***Replacement Parts*** — Standardized manufacture means that should repair and replacement parts be needed, they will fit perfectly into place without fitting. Servicing and repairs can be done at the job with minimum expense.

Chapman Standard Sluice Gates have been job-tested in waterworks, sewage works and flood control projects across the country. They are your assurance of top performance at lowest cost. If your current project calls for sluice gates, be sure to write for revised Catalog 25A and check the big advantages that only the Chapman Standard Sluice Gate Line offers.

THE CHAPMAN VALVE MFG. COMPANY

INDIAN ORCHARD, MASS.

New Oliver Jet Trencher for OC-3 Loader hooks up or detaches in 90 seconds

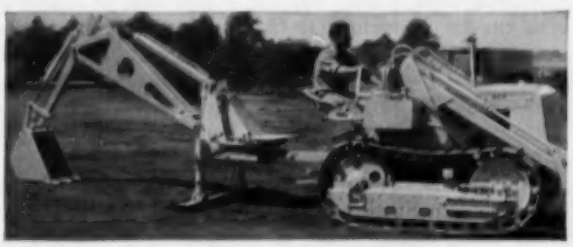
Exclusive 2-point hitch does the trick!

This new Jet Trencher is the perfect addition to the famous Oliver OC-3 Loader. It digs to 12 feet and lifts to 11½ feet—adds extra versatility without limiting tractor maneuverability or loader operation.

The exclusive hydraulic 2-point hitch makes hookup and removal a simple, one-man operation from the tractor seat. When the trencher is removed, the hitch holds the loader counterweight or quickly takes a number of handy attachments—scrapers, scarifiers, etc.

All new in design and construction, the Jet Trencher places all stress and strain on the trencher frame, not on the tractor, Its new mounting, offset to the side of the tractor, gives unmatched visibility and permits close parallel digging to walls, foundations. Full 180° boom swing gives straight side dumping.

Working from the loader hydraulic system, the Jet Trencher has powerful down pressure for digging through tough soil. Hydraulic control gives smooth, cushioned operations and insures long-life, low-upkeep operation. See this new trencher and OC-3 Loader. Ask your Oliver Industrial Distributor for a demonstration.



Hydraulic 2-point hitch is adjusted to fit slots on sides of trencher as tractor is backed into position. Snap-on fittings connect hydraulic lines—seat is swung around and trencher is ready to operate. When not attached, trencher rests, as shown here, on stabilizer blade and bucket.

THE OLIVER CORPORATION

400 West Madison Street, Chicago 6, Illinois

a complete line of industrial wheel and crawler tractors

Looking for millionths of an inch to keep your Crane Valves tighter longer

How big is a micro-inch?

At Crane it's *mighty big* . . . because it is one of the noticeable differences between Crane Quality Valves and the run-of-the-bin kind.

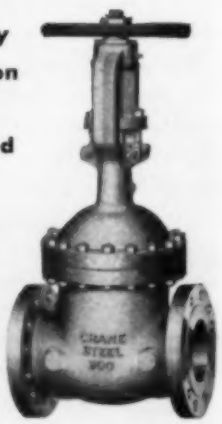
Measuring seating surface smoothness in micro-inches is the job of the Crane technician in the picture. His findings are important to keeping Crane production at the high-quality level.

Crane carefully measures seating surface smoothness to make sure that the Crane Valves you install will operate smoothly without seizure, seat tightly and wear longer, thus helping reduce your maintenance and repair costs to the minimum.

Such care in manufacture for more than 100 years is just *one* reason why thrifty buyers prefer Crane Valves . . . why industry keeps on using more Crane Valves than any other make . . . why you should always buy Crane.

Crane Co., General offices: 836 S. Michigan Ave., Chicago 5, Ill. Branches and Wholesalers Serving All Industrial Areas.

Better Quality
Bigger Selection
in Valves
for Every Need

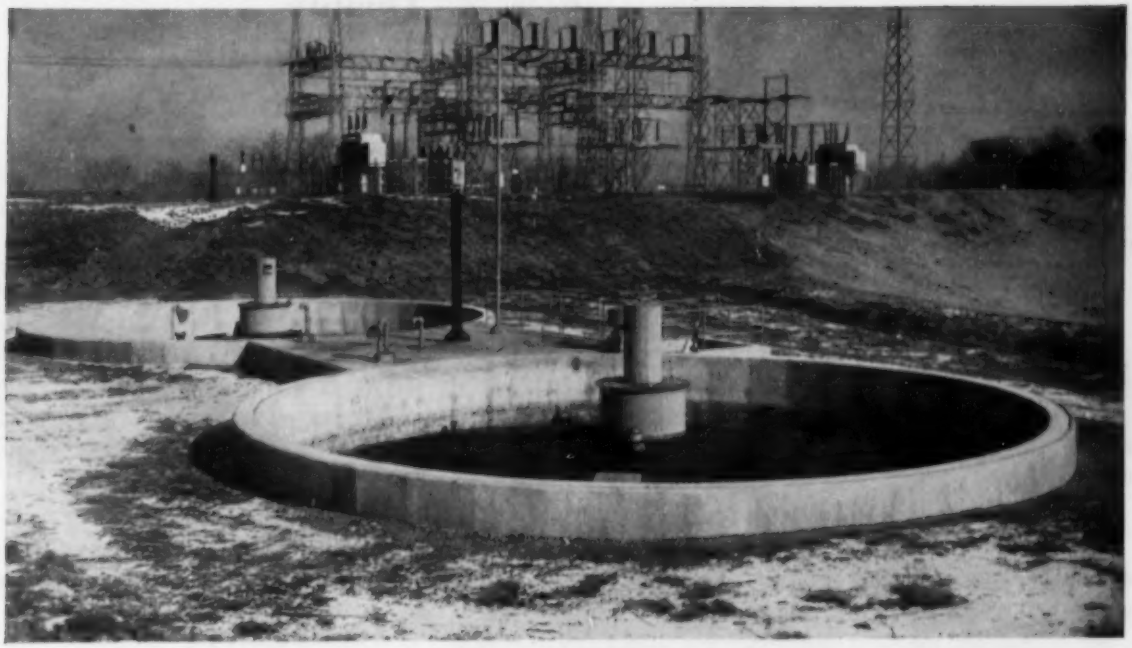


CRANE CO.

VALVES · FITTINGS · PIPE
KITCHENS · PLUMBING · HEATING

CRANE'S FIRST CENTURY...1855-1955

Two PFT Floating Covers on the 40′ underground digesters.

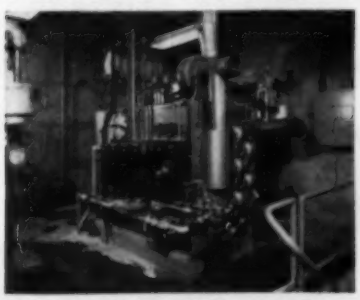


New Eli Lilly plant treats its own wastes

WITH MODERN PFT EQUIPMENT

Completed in 1954, Eli Lilly's modern pharmaceutical plant at Lafayette, Indiana contains a complete waste treatment system for its antibiotic broth wastes, process wash, floor wash and sanitary wastes. An integral part of this highly flexible plant is the PFT "Controlled Digestion" system with provision for direct discharge of the concentrated antibiotic waste to the digesters.

A PFT Floating Cover is installed in each of the two 40′ diameter digesters.



PFT Heater & Heat Exchanger in the underground Control Building.

Floating Covers accelerate digestion and provide positive scum submergence while actually simplifying operations. Because no fixed levels need be maintained, additions and withdrawals can be made at times best suited to the overall operation. Near the covers, a *PFT Waste Gas Burner* burns excess gas and avoids odor nuisance.

In the underground Control Room, a *PFT Heater & Heat Exchanger* unit maintains close temperature control in the digesters *automatically*. Fired by gas *or* oil, the unit cuts fuel costs by utilizing all gas produced in the digesters.

Also in the Control Room are two *PFT Supernatant Liquor Selectors* (with Gauge, Sight Glass & Sampler) and a complete set of *PFT Gas Safety Equipment*.

The PFT Kraus nitrification process is included to assure proper functioning of the trickling filter system with waste which may be deficient in nitrogen.

PFT assisted consulting engineers by showing the adaptability of its processes and equipment in meeting the specific waste treatment requirements of this plant. To further assure successful treatment, PFT instructed plant personnel in the proper operation of its equipment.

Design of plant by / *H. K. Ferguson Co. Cleveland, Ohio*

waste treatment equipment exclusively since 1893

P.F.T.

PACIFIC FLUSH TANK CO.
4241 Ravenswood Avenue
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PORT CHESTER, N. Y. • SAN MATEO, CALIF. • CHARLOTTE, N. C. • JACKSONVILLE • DENVER

for . . .

Quality
Dependability
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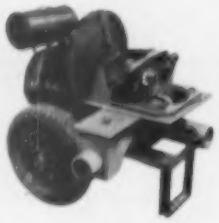
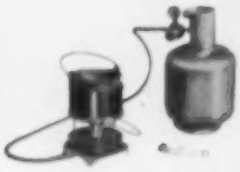
DIAPHRAGM PUMPS



MELTING FURNACES



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CALKING TOOLS

MANHOLE CUSHION

PIPE CUTTERS

SEWER CONNECTIONS

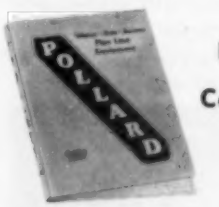
M-SCOPE PIPE FINDER

it's **POLLARD**

for pipe line equipment

and for Convenience . . .

THE NEW POLLARD CATALOG LISTS HUNDREDS OF MODERN PRODUCTS DESIGNED TO MEET YOUR EVERY REQUIREMENT.



Pollard
Catalog 26

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JOSEPH G. POLLARD CO., INC.
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PIPE LINE EQUIPMENT

Place your next order with POLLARD

If it's from POLLARD . . . it's the Best in Pipe Line Equipment

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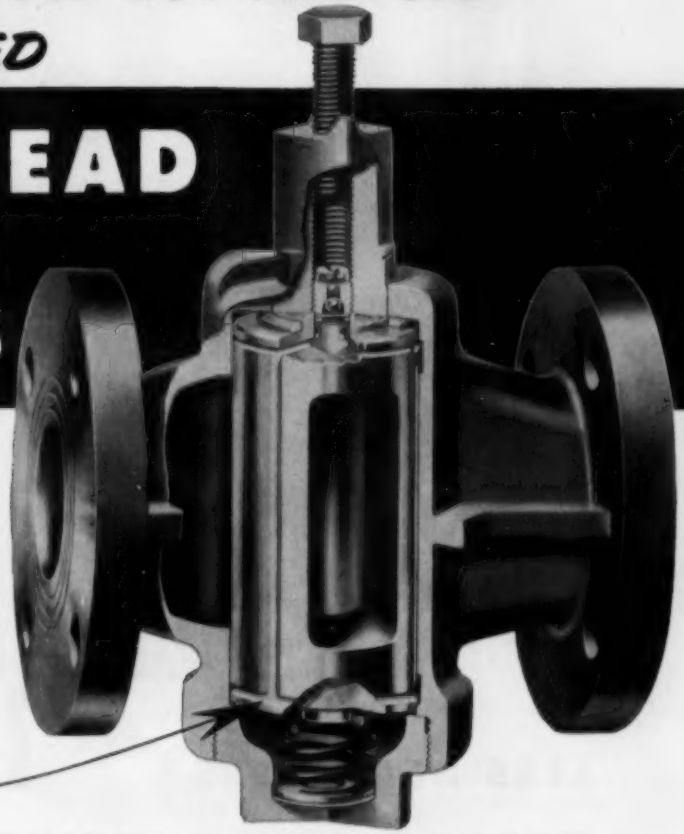
YOU SHOULD BUY AND USE
LOW-PRICED
HOMESTEAD
Lubricated
PLUG VALVES



*SELF-FREEING PLUG PREVENTS STICKING

Homestead's exclusive completely controlled lubricant system positively prevents sticking by its instant, piston-like movement of the plug downward at the start of each lubrication. Spring and line pressure return it to stem-sealed position.

This is only **one reason why you should buy and use low-priced** HOMESTEAD LUBRICATED PLUG VALVES.

HERE ARE ALL TWELVE

1. Extra long valve life assured by very close tolerance between sealing surfaces.
2. Straight line fluid flow—streamlined ports—minimum resistance to flow—minimum pressure drop.
3. Triple head seal—two lubricant rings and reinforced Teflon stem seal prevent leakage.
4. Easy turning—plug floated on Teflon washer and reinforced Teflon ring.
5. Leak-proof double ball and lubricant sealed check valve. No springs. No maintenance.
6. Full-threaded screw prevents dirt being forced into lubricant system.
7. Quarter-turn fully opens or closes.
8. Reinforced Teflon stem seal—no cold flow—continuous, positive seal.
9. Seating surfaces protected in both open and closed positions.
10. High pressure lubricant system provides full lubricant seal around ports.
11. Self-freeing plug prevents sticking.
12. Two lubricants handle most services.

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VALVE MANUFACTURING COMPANY
"Serving Since 1892"

P. O. Box 42 **Coraopolis, Pa.**

Without obligation, send Reference Book 39—Section 5 on HOMESTEAD LUBRICATED PLUG VALVES.

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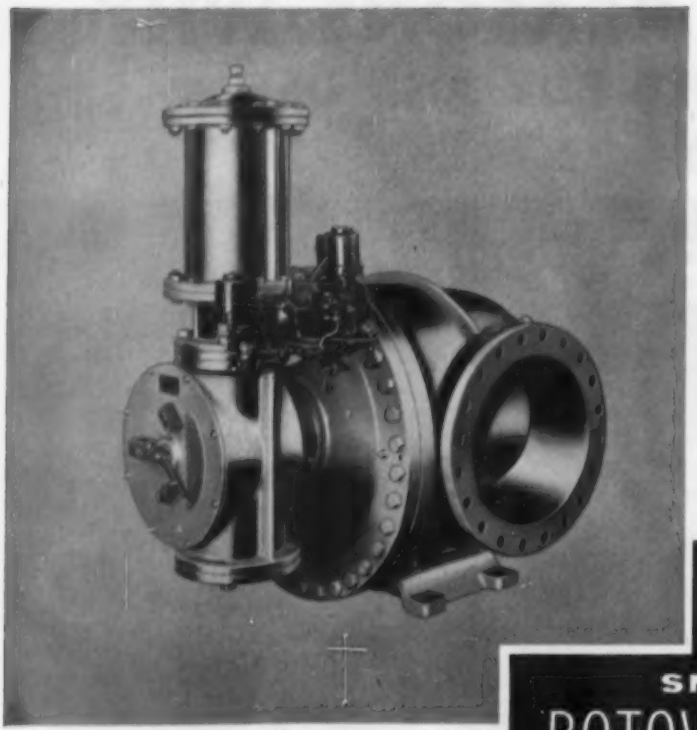

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ROTOVALVES

LESS HEAD LOSS
MEANS LOWER PUMPING COSTS

Free, unobstructed flow through SMS-Rotovalves means a lower head or pressure loss, helps you keep pumping costs down. The full line opening shown in the drawing above offers no more resistance than a straight piece of pipe of the same diameter.

Rotovalve design solves many control problems. The conical plug first lifts, then rotates and finally reseats. You get easy operation, precise aperture control, controlled closing time, tight and positive closing, easy mechanical cleaning, low maintenance, long life.

These high-performance characteristics are the result of over 75 years of engineering and research experience in the hydraulics field. For detailed information on Rotovalves, contact our local representative or write to the S. Morgan Smith Company, York, Pennsylvania.

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Pumps
Gates & Hoists
Trash Rakes
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HYDRODYNAMICS

Rotovalves
Ball Valves
Butterfly Valves
Free-Discharge Valves
Controllable-Pitch Ship Propellers

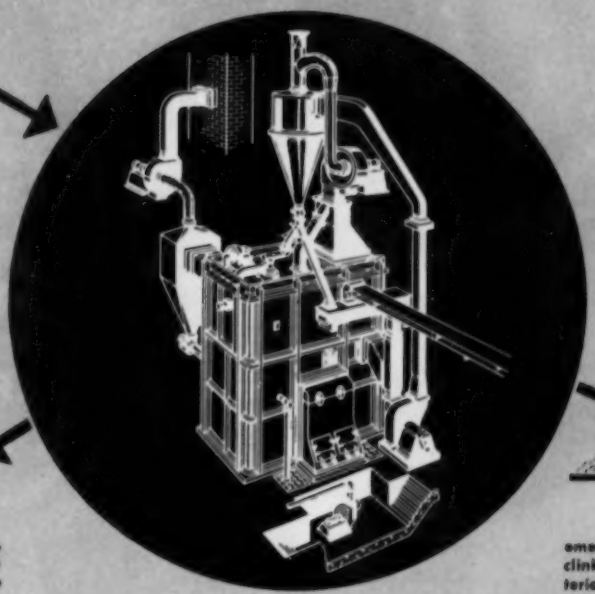
S. MORGAN SMITH CO.

The C-E Raymond System —

the MODERN method of SLUDGE DISPOSAL

SLUDGE

as a vacuum filter cake or thickened sludge from any type of sewage treatment process enters the C-E Raymond System.



SOIL CONDITIONER

emerges as a desirable product, easy to handle, exceptionally rich in humus, and containing the trace elements found in good topsoil.

and / or

ASH

emerges as a fine dust, free from clinker and unburned organic materials.

The C-E Raymond System is the most popular . . . most versatile on the market today. It combines the principles of Flash Drying and Incineration in a single compact system that allows you to Flash Dry or Incinerate sewage sludge alternately or concurrently. It is available with a high temperature deodorization system that assures odor-free operation.

Flash Drying by the C-E Raymond System is a continuous process in which vacuum filtered sludge — if uncontaminated with undesirable industrial wastes — is efficiently heat dried to a marketable soil conditioner retaining all its original nitrogen, but eliminating the objectionable qualities of the original wet sludge. In a well designed and operated "activated plant" the revenue from the sale of soil conditioner is sufficient to cover a sizable part of plant operating costs.

Where the production of soil conditioner is not desired or the sludge is unsuitable, it is flash dried and then completely burned in suspension to an easily disposable, sterile ash.

The services of C-E specialists are available to help you plan for the end of atmospheric or stream pollution in your community, as has been done in so many others. For specific recommendations on the most practical answer to your sludge disposal problems, get in touch with the Combustion office nearest you.

C-E

B-860

COMBUSTION ENGINEERING

RAYMOND DIVISION

1315 North Branch Street, Chicago 22, Illinois

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also flash drying and incineration systems for industrial waste disposal

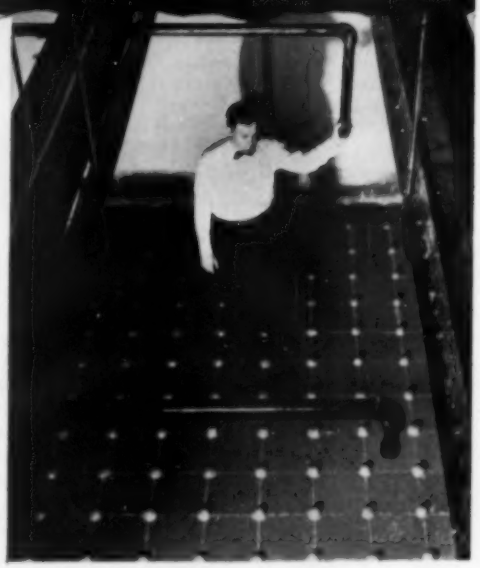
MOUNT CLEMENS, MICHIGAN, WATER SYSTEM INSTALLS ITS FIRST ALOXITE® POROUS UNDERDRAIN

Robert Hansen, superintendent of the Mount Clemens, Mich., Water Purification Plant and Pumping Stations, has been studying methods of filtration for many years. During this time, he has constantly sought more effective ways to get longer life between filter rebuilds.

The Mount Clemens filters were installed in 1929. They are conventional in design, with manifolds, perforated laterals and, until two years ago, graded gravel and sand throughout. Although mudball formation was a problem some years back, Mr. Hansen says, "The greatest difficulty in filters, as I see it, is the mixing and mounding of the various grades of gravel. Some bottoms have been designed to reduce the amount of gravel used and thereby reduce the troubles due to gravel. But the only type I know of that eliminates gravel entirely is the porous plate bottom."

For example, in spite of a complete rebuild of three filters in 1947, one needed a complete rebuilding again only six years later. This time, on Mr. Hansen's recommendation, the Mount Clemens City Commission agreed to the installation of a set of ALOXITE fused aluminum oxide porous underdrain plates. So far, the new plates have been in operation two years, and Mr. Hansen reports that he is highly optimistic about their future life expectancy.

The Mount Clemens City Commission is to be congratulated on its progressive attitude and willingness to investigate new and improved methods. And Mr. Hansen deserves much credit for his painstaking and thorough study of filter construction and media.



Robert Hansen, superintendent of the Mount Clemens Water Purification Plant and Pumping Stations, stands on a section of the new ALOXITE porous underdrain immediately after its installation.

36-page booklet tells how porous-plate underdrains can be applied to virtually any filtration or diffusion operation. Write for your free copy today!

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give *tighter* shut-offs

Only Mueller Gate Valves have the exclusive "four-point contact" disc wedging mechanism. Closing pressure is equally distributed to four separate points near the outer edge of each disc. Shut-offs are made faster, easier and tighter - without disc deflection or sliding contact. See your Mueller Representative, Catalog W-96 or write today for full details on the complete line of Mueller Gate Valves.

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"O" Ring Seal or Conventional Packing
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Hub, Flanged, Spigot, Universal, Screwed, Mechanical Joint or "Ring-Tite" Ends
Sizes 2" through 48"

"O" Ring Conversion Kits now available for all Mueller Non-Rising Stem Gate Valves up to 12", which were originally equipped with conventional packing.

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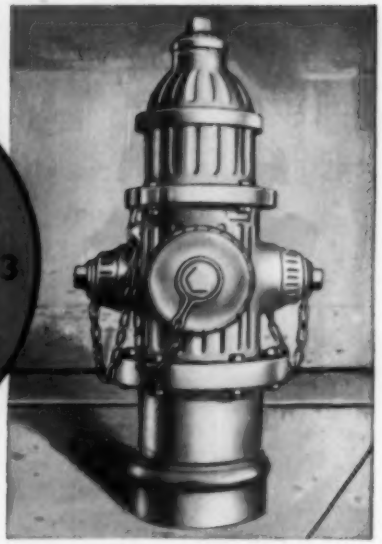

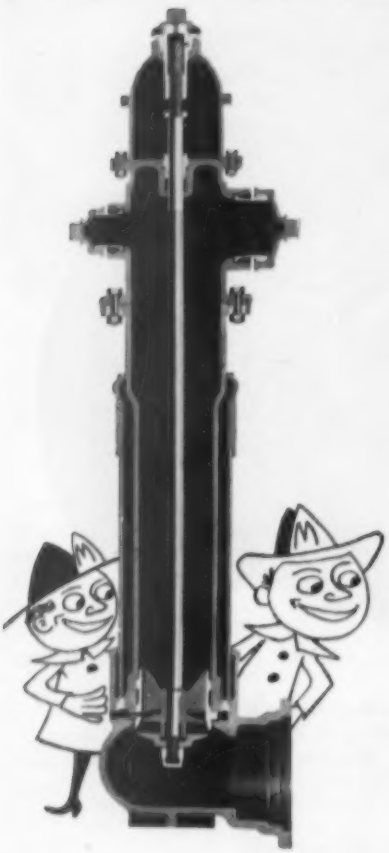

Replaced in less than half an hour

WITHOUT EXCAVATING

The Mathews Modernized Hydrant is the leader in its field because it is simple in design and quickly accessible for repair or replacement. Here are some of the outstanding features of the Mathews Modernized Hydrant.

The Replaceable Barrel. Contains all working parts and can be replaced with another in jig time *without excavating*. When the hydrant is broken in a traffic accident, fire protection is interrupted for less than 30 minutes!

Compression-Type Main Valve. The Mathews Hydrant uses water pressure to help tighten the valve. No leaks, even when the hydrant is bowled over by a truck.

Stuffing Box Plate. Cast integral with the nozzle section, eliminates an extra part and a flange joint. A stronger, safer, leakproof construction.

Operating Thread. The stuffing box plate prevents water and sediment from reaching the operating thread. No rust can form. No ice can jam it in cold weather.

All these other quality features: Head turns 360° simply by loosening bolts • Replaceable head • Nozzle sections easily changed • Nozzle level can be changed without excavating • Protection case of "Sand-Spun" cast iron for strength, toughness, elasticity • A modern barrel makes an old Mathews good as new • Mechanical joint pipe connections optional

Send for this 80-page catalog. It contains full information about the R. D. Wood line of Cast Iron Pipe, Fire Hydrants, Gate Valves, and Hydraulic Machinery.

MATHEWS HYDRANTS

Made by R. D. Wood Company

Public Ledger Building, Independence Square
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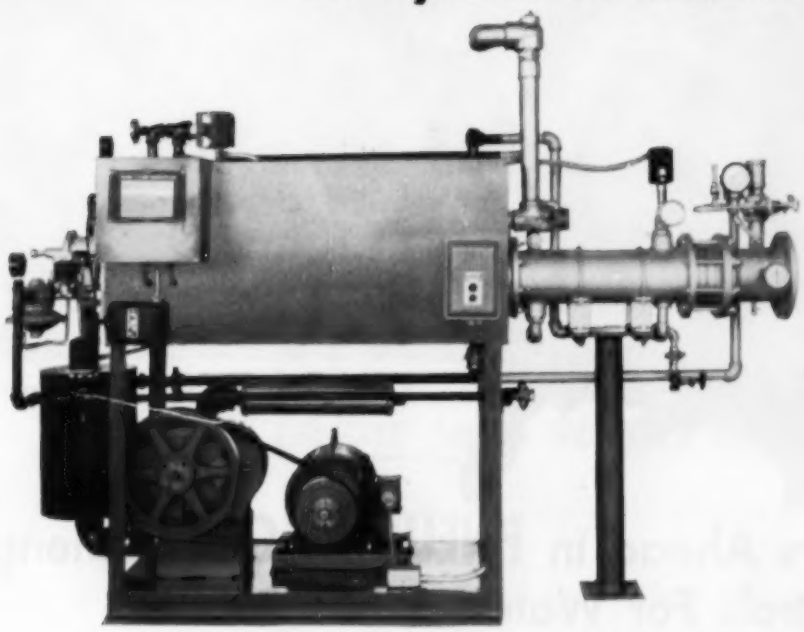
Manufacturers of "Sand-Spun" Pipe (centrifugally cast in sand molds) and R. D. Wood Gate Valves

50% MORE CO_2

for your recarbonation basin



with the

WALKER PROCESS Carball CO_2 unit

The specially designed CARBALL burners, using gas or oil, produce up to 50% more CO_2 per unit of fuel. Complete combustion of the fuel and air mixture is attained by 100% burner efficiency . . . producing *all* available CO_2.

Combustion is performed at extremely high temperatures which completely eliminates condensable carbon and other objectionable by-products and provides a clean, tasteless CO_2 gas which requires no scrubbing.

Compressing clean, cool air and charging it into the pressurized CARBALL combustion chamber prevents hot corrosive gas troubles commonly found in older systems.

Request bulletins 7W83 for complete details of the CARBALL and 7W85 for discussion and charts dealing with the mechanics of recarbonation.

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WALKER PROCESS EQUIPMENT INC.

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Because this equipment is specially designed for water works service, the Builders Pneumatic System is outstandingly successful in operation. Builders Pneumatic Instruments and Controls are now giving top performance on many important installations across the country, including Chicago's South District Filtration Plant, the world's first and largest pneumatically equipped plant, built in 1946.

Builders Pneumatic Meters and Controls are right for water works service in every detail — in accuracy, in range, and in materials of construction. Each system profits by our broad design and manufacturing experience . . . a "plus" service we extend to engineers to help in obtaining the correct instruments and controls for each project. Builders-Providence equipment is backed by our own nationwide organization of service specialists . . . another assurance of economical plant operation.

For a first-hand look at the advantages of Builders Pneumatic Instruments and Controls, visit one of the many installations now in service. We will be glad to help arrange such a visit for you. Write Builders-Providence, Inc., 350 Harris Ave., Providence 1, Rhode Island.

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C.P.G.—means cost per gallon and water costs are an all important item to city — farm or industry.

The man from Layne knows most about water costs and how to cut them—for the man from Layne knows most about every phase of water development.

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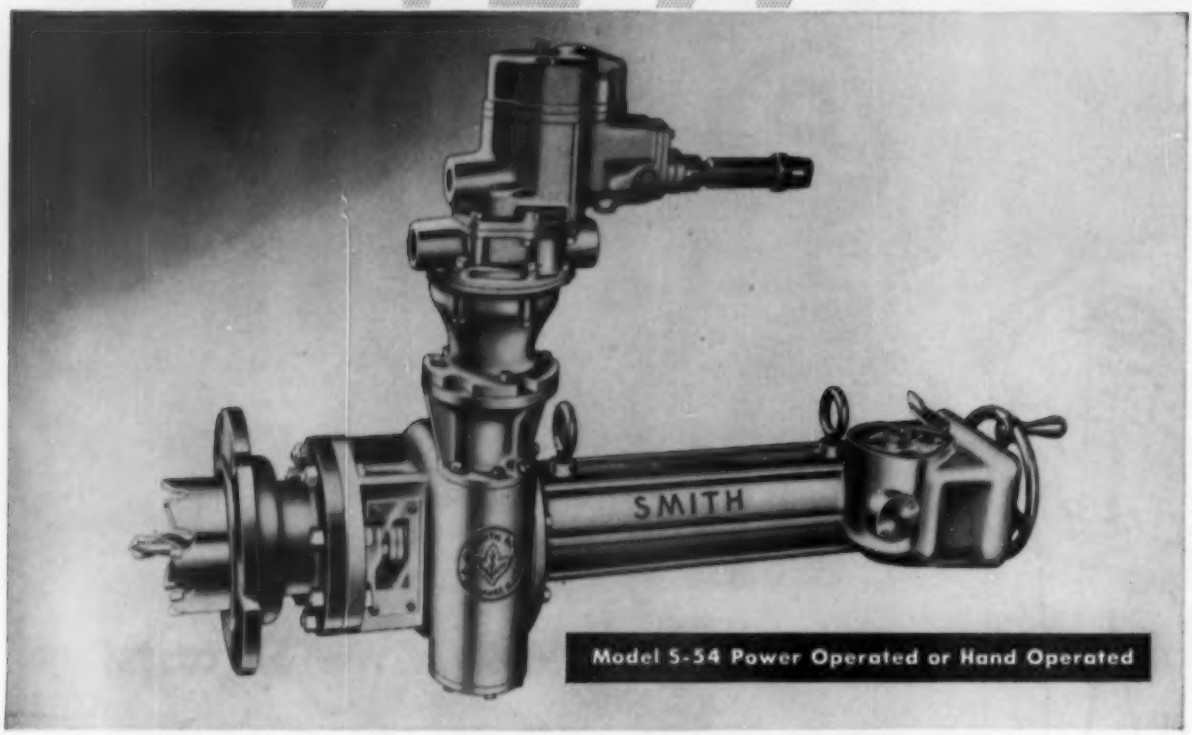
NEW SMITH TAPPING MACHINES FOR TAPS 2″ THRU 12″ INCLUSIVE



The A. P. Smith Mfg. Company in 1896 introduced the first Tapping Machine for making connections sizes 2″ and larger to fluid and gas service piping under pressure. The *NEW* Smith S-54 Tapping Machine is the most modern, efficient and economical machine available. The S-54 Smith Tapping Machine is used with Tapping Sleeves, Hat Flanges, Saddles and Tapping Valves to make 2″ through 12″ connections under pressure to Cast Iron, Cement-Asbestos, Steel and Reinforced Concrete Pressure pipe. 1. AUTOMATIC FEED: Positive automatic feed insures correct drilling and tapping rate. Hand feed is provided to rapidly advance and withdraw Cutter. 2. TRAVEL INDICATOR: Chart attached to machine indicates travel required to complete tap. Travel is *AUTOMATICALLY* terminated when tap is completed. Cutter and shaft cannot overtravel. 3. COMPACT CONSTRUCTION: Telescopic shaft reduces overall length. 25″ travel is adequate for 2″ through 12″ taps to any size of pipe. 4. ENCLOSED CONSTRUCTION: Mechanism is housed in heat treated Aluminum Case filled with lubricant. Foreign matter cannot enter and damage mechanism. 5. STUFFING BOX AND PACKING GLAND: Accessible without disassembling machine. Equipped with Chevron packing. Line pressure cannot enter machine case. 6. RUGGED CONSTRUCTION: Extra large diameter telescopic shaft adds strength and rigidity. Timken radial—thrust bearings maintain alignment, reduce friction and wear. 7. DRIVING GEARS: Worm gearing operates in lubricant, torque is reduced to the minimum. 8. CUTTERS: Have replaceable Flat and Semi-V alternate teeth of High Speed Steel or Tungsten Carbide. 9. FLEXIBILITY: Hand Operated Machines can be converted to Power Operation by interchanging worm gearing. 10. AIR MOTOR: The motor attaches directly to the Power Operated Machine without Brackets, Holders, Adapters or Couplings. Bulletin sent on request.

52

FIRE HYDRANTS · VALVES · SINCE 1896

THE A.P. SMITH MFG. CO.

EAST ORANGE . NEW JERSEY

TELEMETERING

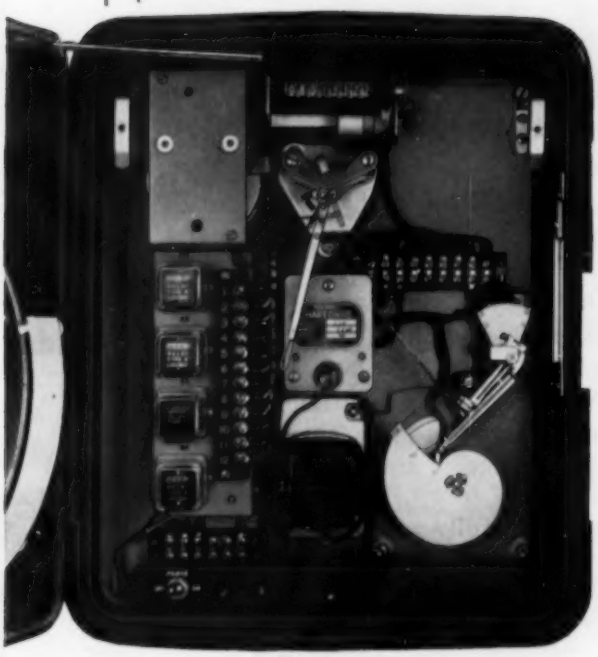
with unique new freedom from maintenance!

Transmitter

TELETAX by Foxboro

ANY TRANSMISSION SYSTEM

two wires
one wire and ground
radio or microwave
carrier current



Receiver

You can now get the full benefit of Foxboro accuracy and reliability for *remote* measurements, too! Teletax, the Foxboro impulse-duration system, brings new durability and simplicity to telemetering. For example, in the compact Teletax Receiver, dust-proof, plug-in relays and a husky reversing motor drive the recording pen positively. Maintenance is all but eliminated. And when servicing *is* necessary, *every* component is easily replaceable as a separate unit.

Teletax will transmit any measurement made with standard Foxboro measuring elements. Accuracy is ½% of full scale . . . regardless of normal variations in signal strength. Get full details on Teletax efficiency and economy. Write for Bulletin 17-11.

Most Practical System You Can Get!

RELIABLE: Thoroughly proved in actual field installations.

ECONOMICAL: Operates on lowest-cost transmission circuits.

LOW MAINTENANCE: A few drops of oil in the receiver motor every three months is all that's required; low 5 ma dc signal avoids failures.

Single or dual transmitter or receiver; indicating or recording; totalizing available.

THE FOXBORO COMPANY, 8910 NEPONSET AVENUE, FOXBORO, MASSACHUSETTS, U.S.A.

FOXBORO
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TELETAX
(impulse-duration) Telemetering

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

Our Present Position, and Future Goals

DURING THE past several years, much of our pioneer work has matured into reality as our Coilfilters go into operation. In addition to having successful operations, it has been our thought to maintain close relations with the Contractors involved in the building of these plants, the Engineers who do the design work, and the Operators who live with the installations. Despite the trials and tribulations that seem to be a part of this type of work, I believe that we have gained many friends among all the people involved in these projects.

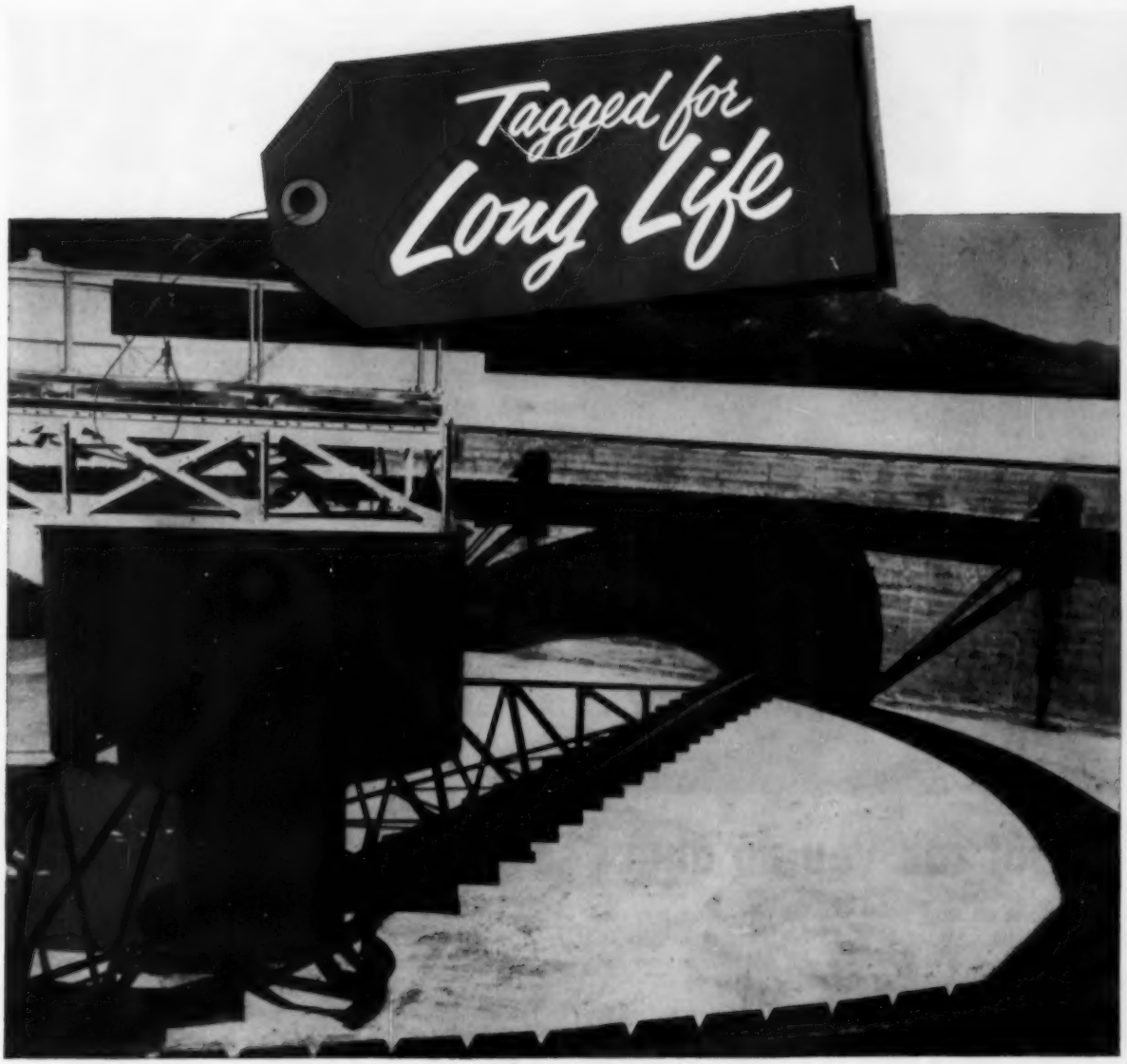
With reference to sludge dewatering technology, we can see a distinct trend toward the direct dewatering of raw sludge on our Coilfilters. On installations operating to date we have been able to find an answer for the odor problem. This, of course, is a large factor, in addition to the economics involved.

With regard to the future, we believe that research, both theoretical and applied, is indicated on the fundamentals of solids agglomeration. We have been fortunate in being able to set up an organization with facilities to do work along these lines.

In perspective, we believe that a splendid job has been done in the past five years on sanitary installations in this country, and are indeed gratified to be accorded a place in this work. Currently our proportion of total sludge dewatering installations is very impressive and we intend to maintain our position through continued service to the Engineers, Contractors, and Operators.

Respectfully,
T. R. Komline

KOMLINE-SANDERSON
ENGINEERING CORPORATION
MANUFACTURERS OF THE COILFILTER
PEAPACK, NEW JERSEY



. . . because it's protected with PITT CHEM® Tar Base Coatings

THIS water system clarifier tank is getting the right start in life. It's being given "life insurance" with Pitt Chem 103 Tar Base Coating—one of the toughest and most durable protective coatings ever developed to stop water and sewage plant corrosion.

Pitt Chem Tar Base Coatings outlast ordinary paints by many times. Yet they cost no more per gallon. They are easy and economical to apply and form a tight, lasting bond with metal, masonry, concrete and stone.

Here's the story in a nutshell: *No other material does such a complete job of protection at so little cost.* If you want to stop water sewage corrosion—and reduce costs in the bargain—call for a Pitt Chem corrosion engineer today to survey your specific problems. A call, wire or letter will place him at your service.

W & S 0458

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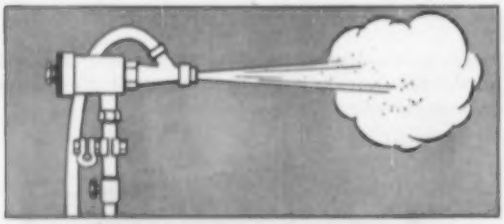
What can you do about sewage odor complaints?

Even the most modern sewage plant often gets complaints from the public. When care, cleanliness and chlorination fail, and you still get sewage odor complaints, what can be done?

A group of Airkem odor counteractants is solving this problem for sewage plants throughout the country. Application is simple: the odor counteractant is dispersed into the air through air-spray nozzles. Molecular dispersion combines the counteractant with the atmospheric airstream to reduce odors immediately.

Air inversion is often the cause of odor complaints. When atmospheric conditions block off normal odor-escape routes, odors cling to the ground and often develop into a public relations problem. Airkem solves this problem because it covers every dispersion area.

A consultation with Airkem will be completely confidential and there is absolutely no obligation. Call your Airkem representative listed in the phone book or write Airkem, Inc., 241 East 44 Street, New York 17, N. Y.



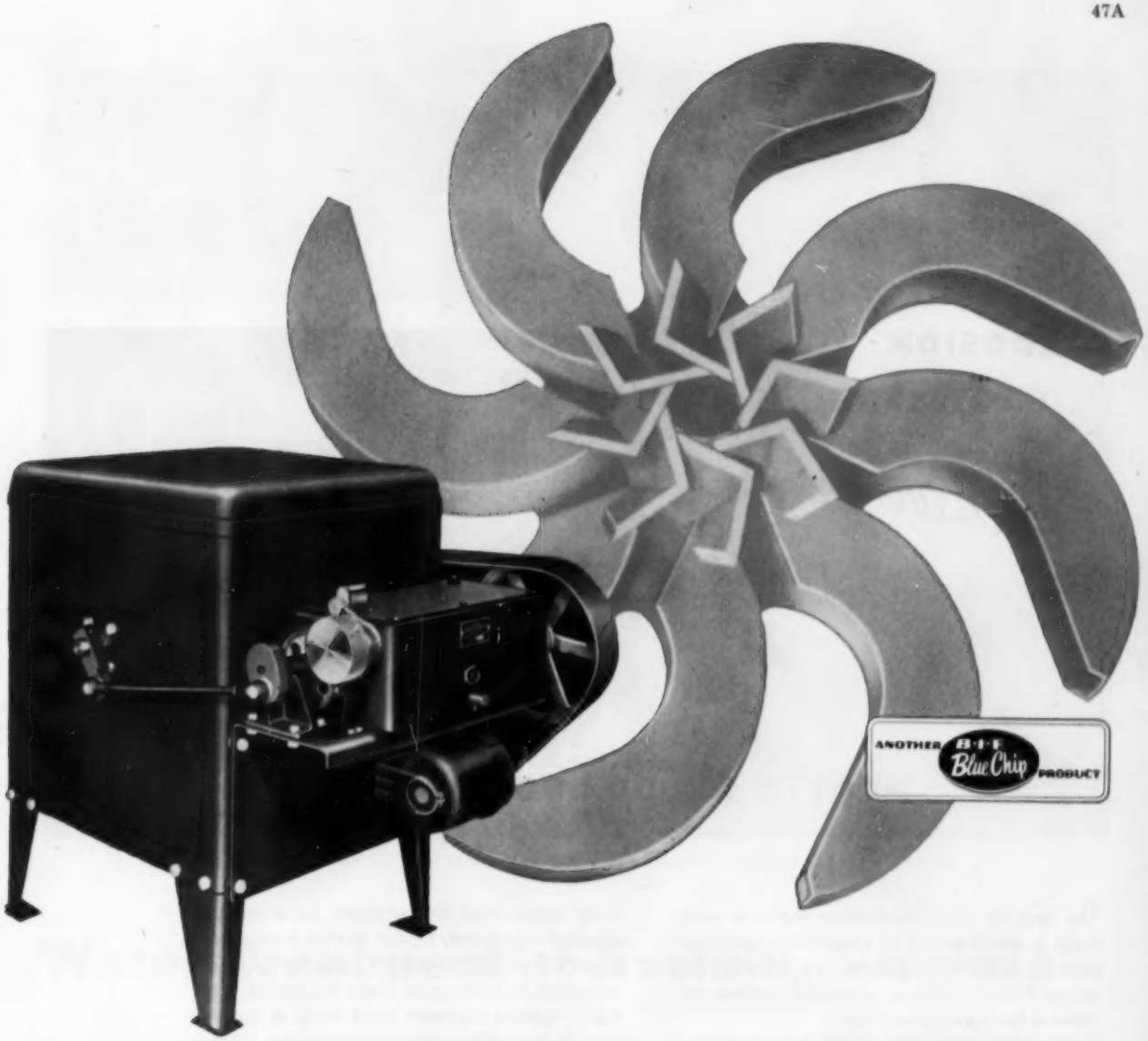
Airkem air-spray nozzle disperses effective odor counteractant into atmospheric airstream.

Airkem covers entire dispersion area under air inversion conditions. Counteracts odor immediately.

For Industrial • Municipal • Institutional • Commercial Use

AIRKEM ODOR COUNTERACTANTS

airkem



THE WHEEL OF FORTUNE FOR LIQUID CHEMICAL FEEDING

Because of its unique rotary dipper wheel, the Omega Rotodip Liquid Feeder is the low-cost, low-maintenance answer to many liquid chemical feeding problems. Rotodip sure pays dividends on feeding jobs like these: carbon slurry for taste and odor control . . . liquid alum for coagulation or sulfuric acid for pH control . . . ferric chloride feeding for sewage sludge conditioning. Consider the many advantages which are yours in using a Rotodip: wide-range adjustability (100 to 1) — high repeatable accuracy (within 1%) — complete simplicity (very low on maintenance) — easy adaptability to automatic control systems — direct-reading gallon-by-gallon totalizer.

Send for new Bulletin 65-H12A . . . a detailed description of this accurate and efficient feeder. Omega Machine Co., 350 Harris Avenue, Providence 1, R. I.

OMEGA *THE LAST WORD IN* FEEDERS

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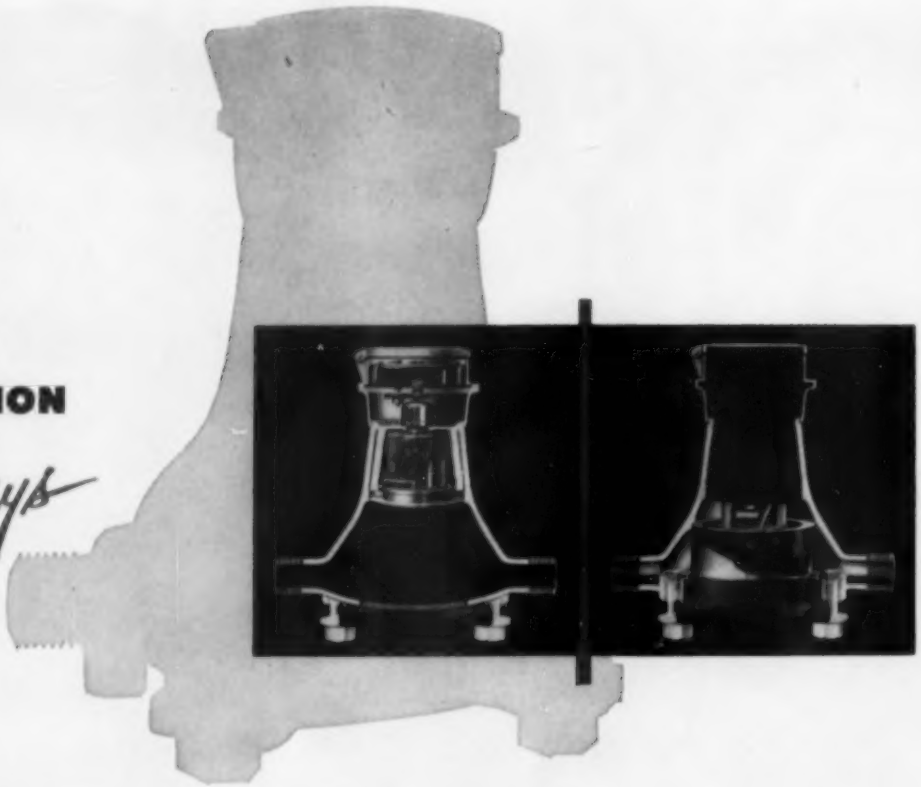
BIF METERS FEEDERS CONTROLS



CORROSION PROTECTION

Two ways

PROVED 10,000,000 TIMES

The toughest, most dependable test of a water meter is actual service . . . in millions of applications . . . under all conditions. This is the test that proves Trident's two-way protection against corrosion is the finest you can buy.

The entire upper half of the Trident meter is *isolated* from corrosion. Gears and bearings . . . and most important . . . stuffing box spindle and packing are sealed in a non-corrosive water-oil emulsion. These vital parts get 100% protection in *any* water. And they're lubricated for life.

The material in the measuring chamber is also important. There is no one material that stands up in all waters. Most Trident meters use a carefully selected, high quality bronze that has been proven in millions of applications to be best for most local conditions. In some cases where this bronze is not right, Neptune engineers stand ready to test and provide special corrosion-resistant alloys. Since a slight defect or change in the formula may make all the difference, Neptune exercises extremely close metallurgical control with modern electric furnaces.

When you buy Trident Meters, you get two-way protection against corrosion . . . dependable protection proved by millions of applications.

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WATER & SEWAGE WORKS

VOL. 102, NO. 11 • A Scranton Gillette Publication • OCTOBER, 1955

FILTER and laboratory building at new Moores Bridges water treatment plant serving Norfolk, Va.

Water Treatment at Norfolk, Virginia

by S. M. HODGES and W. G. BEAZLEY

Mr. Hodges is Assistant Superintendent and Mr. Beazley is Production Manager, Division of Water Supply, Norfolk, Va. **This article describes the growth and improvements made in the water system of that city since the system's beginning in 1873.**

THE City of Norfolk, Virginia, has long been an important port, not only to commerce and industry but also to the United States military forces. Its growth from 144,332 in 1940 to 213,513 in 1950 is indicative of that importance, particularly during the World War II years.

As might well be expected, this growth not only brought expansion problems to the municipality, but also brought expansion problems in the Norfolk Division of Water Supply.

Early History

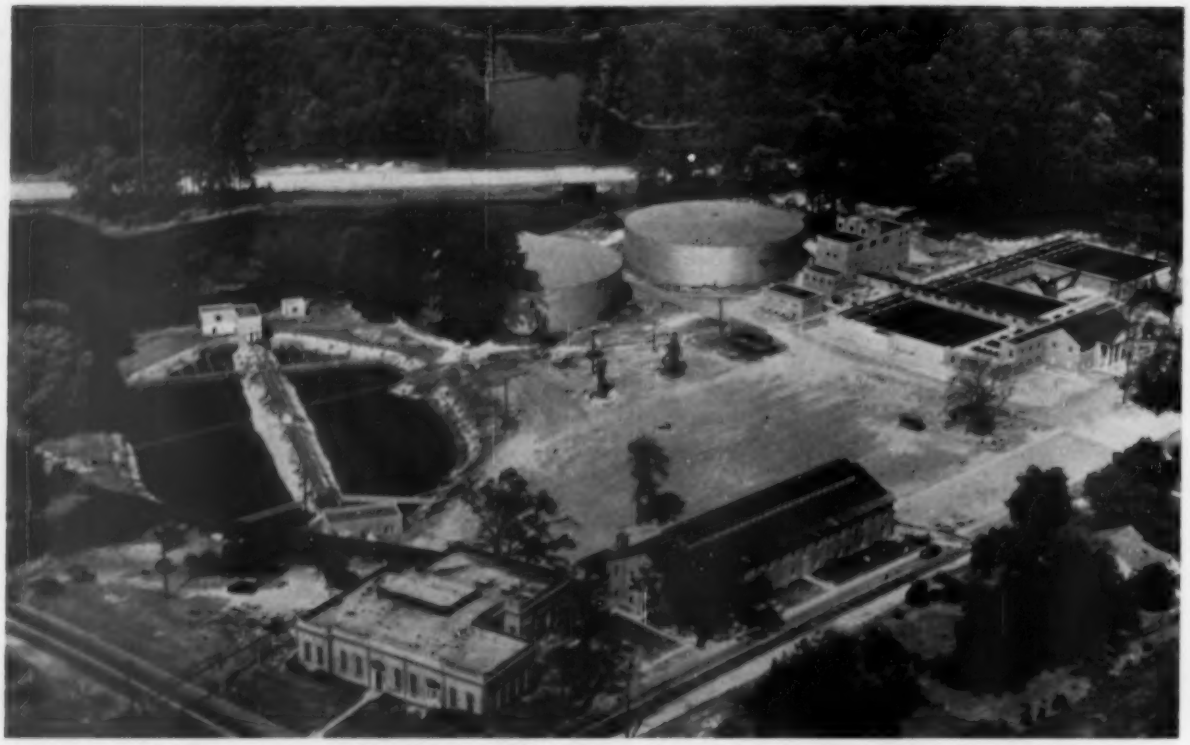
The Norfolk Municipal Water System began delivering water in August 1873. It then consisted of an impounding reservoir storing approximately 60 million gallons, a pumping station with a maximum capacity of 1 million gallons per day, 5 miles of 12-inch transmission main, and approximately 4 miles of 6-inch and 4-inch distribution mains. The reservoir and pumping station were located 5 miles east of the city in Princess Anne County.

This system had a normal growth through the 1870's and 1880's. In 1885, and again in 1900, new reservoirs were created adjacent to the original one by damming up old salt water marshes.

In the early 1890's it was realized that the water as delivered was not of the highest quality and that some means of improving it must be found.

The first effort was aeration. At first air was pumped into a small reservoir just before the water entered the pump suction. Later this point of application was changed to the distribution main a short distance from the pump discharge.

Along with the aeration experiment, the city began the study of artesian wells in 1891. Several firms of consulting engineers were employed to study the feasibility of a well supply between 1891 and 1896



GENERAL view of old (left) and new (right) Moores Bridges plants

with the final result being a 12-inch well driven about 1,600 feet deep. The quality of this water was not good.

In 1896 the investigation of rapid sand filtration was begun, the ultimate result being the construction of a purification plant in 1899 adjacent to the pumping station. This plant consisted of intake and screen chambers, dosing well, solution feed, baffled mixing basins, settling basins, rapid sand filters and clear water storage.

The original treatment plant had a rated capacity of 8 million gallons per day and was equipped with wooden tub filters, which were equipped with mechanical rakes. Various chemicals were tried as coagulants, but alum was found to be the most efficient. In 1906 new pumps and chemical feed equipment were installed to meet the anticipated demand caused by the large influx of people attending the Jamestown Exposition.

World War I

At the outbreak of World War I, Norfolk became one of the principal ports of embarkation. As a result it became greatly overcrowded with civilians as well as servicemen. It soon became evident that the municipal water supply facilities were inadequate.

The properties of the Norfolk County Water Company, a privately owned corporation operating in territory adjacent to the city, were obtained by the city, first through lease and later by outright purchase. During this period additional filters were added to the original treatment plant, bringing its rated capacity up to 16 million gallons per day, or double that of the plant completed in 1899.

By the close of the war, it was realized by the city officials that it was necessary to go farther afield to secure a more adequate permanent supply. A site was accordingly secured on a stream tributary to the Nansemond River some 20 miles west of the city in Nansemond County. A dam was constructed across the valley of this stream, forming a reservoir which impounded 3.7 billion gallons of water. This supply was connected by pipeline with a newly constructed treatment plant of 12 million gallons per day capacity located in the western section of the city.

Coincidentally with the construction of this new supply, the old supply, now known as the Moores Bridges supply, was completely overhauled. New concrete filters replaced the old wooden tubs; steam and electric pumps were installed. This Moores Bridges plant was equipped with over-and-under and around-the-end mixing baffles in the coagulation basin.

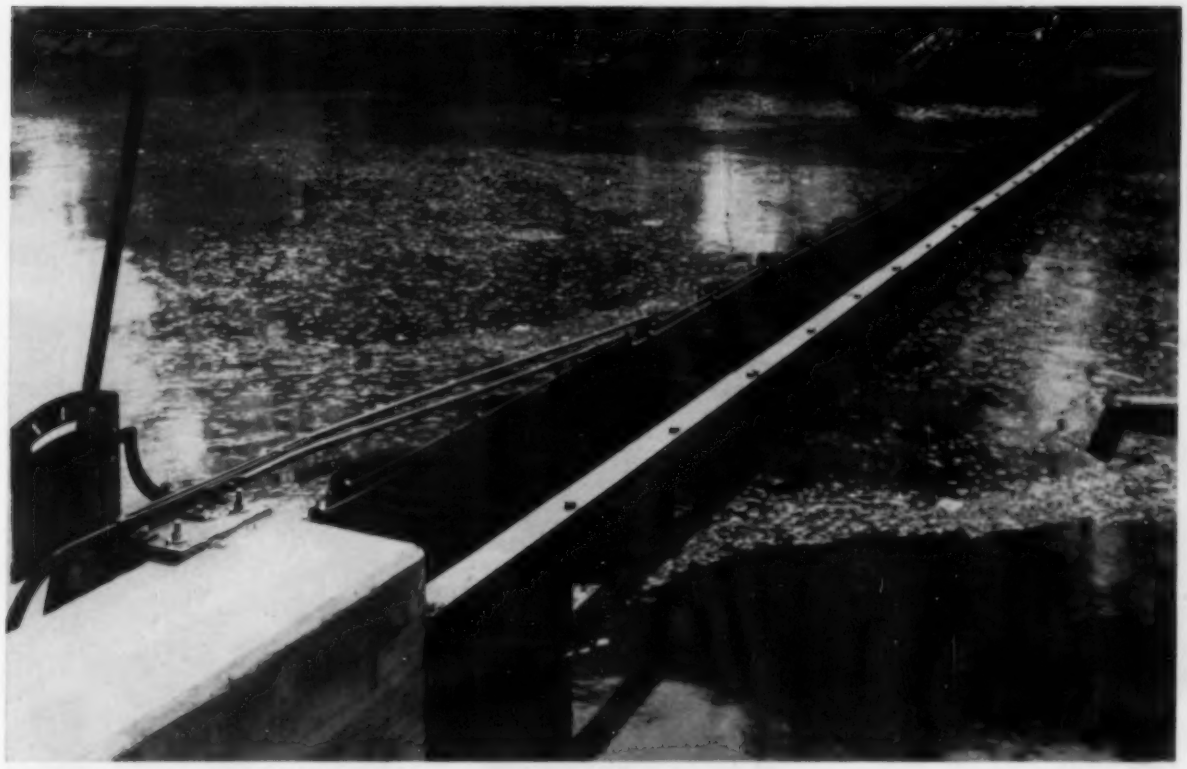
The 1930 Decade

During the drought period of the early 1930's, numerous emergency changes had to be made at the intake because of extremely low water conditions in the storage reservoirs. When these alterations were readjusted to normal operation, mechanical rapid mixing was installed immediately ahead of the over-and-under baffles. This installation was completed in 1934.

Because the flocculation and sedimentation basins were irregularly shaped, short circuiting occurred frequently. To reduce short circuiting, slotted wooden baffles were installed about one-third of the length along the basin from the influent. These baffles helped conditions at normal rates of flow, but when the rate of flow was high or when turbidities were high a large amount of floc was carried over to the filters.

The 1940 Decade

This purification system was adequate during the normal increase in demand in the 1930's. However, there was a tremendous increase in military activity in the Norfolk area immediately preceding Pearl Harbor and the demand for water grew enormously. As a result, a new reservoir of 3.4 billion gallons capacity was developed



ADJUSTABLE Venturi-type distributing baffle was installed in old plant basin in 1944

in Nansemond County adjacent to the one constructed in the early 1920's. Also, the capacity of the purification plant in the western section of the city was doubled and the equipment modernized.

During this same period a severe drought along the Atlantic seaboard depleted the reservoirs to such an extent that it became necessary to use water from the Dismal Swamp Canal. Although Dismal Swamp water was highly regarded by captains of sailing vessels because of its ability to remain "sweet" for long periods of time, the modern housewife objected strenuously to its excessive color. This color was difficult to remove because of low alkalinity, low turbidity and poor floc forming qualities. These conditions made it imperative that the water treatment facilities at the Moores Bridges plant be improved. Therefore, a modernization program was begun in 1944.

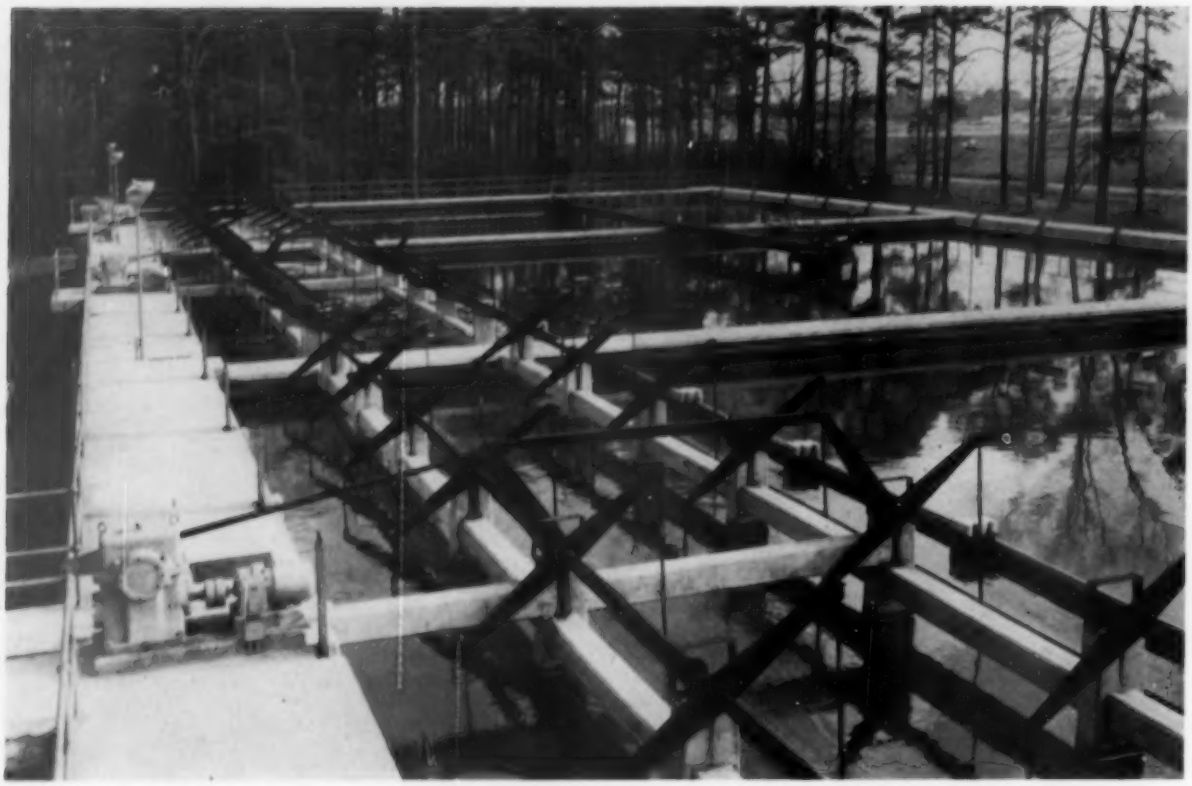
The Then New Walking-Beam Flocculator Chosen

Before final decisions were made on revisions to the flocculation facilities, investigations were made of all types of mechanical flocculating equipment then available. Because of the irregular shape of the flocculating basin, it was found that the then very new walking-beam type flocculator could be most easily and economically adapted to these basins.

Because the walking-beam flocculator has its bearings and driving mechanism above ground and out of the water, it was possible to install the new equipment without the necessity for constructing a dry well. In conjunction with the installation of the walking-beam flocculators, a series of adjustable Venturi-type baffles was installed. These baffles could be adjusted to eliminate substantially all short circuiting of flows through the basins.

When these revisions were made it was possible to produce consistently a water of decidedly better quality, even at high rates of flow, and to produce enough water to meet the ever-increasing demand. Contrary to expectations, when World War II hos-

WALKING-BEAM flocculators were in good enough condition to be re-used



WALKING-BEAM flocculator installation in new plant has all wearing parts out of water, making for easy maintenance

tilities ceased, there was little decrease in water demand.

It then became evident that the population of Norfolk would continue to grow, and with it the demand for water. To meet this continued growth, the need for a larger water system was obvious.

Recent Additions

The city engaged a consulting engineering firm to survey the entire utility. The consultants recommended a $13,000,000 expansion program. The city adopted the program, which consisted in part of:

1. Demolition of three filters in the old filter plant and the rehabilitation of the remaining into a 12 million gallon a day filter plant, based on a rate of 2 gpm per square foot.

2. Building a new 12 million gallon per day filter (also at 2 gpm per square foot) and laboratory building.

3. Construction of four new coagulation basins with a 24 million gallon per day rated capacity.

4. Construction of a completely new chemical building.

5. Construction of a 48-inch transmission main from the western reservoirs to augment the original Moores Bridges source of supply.

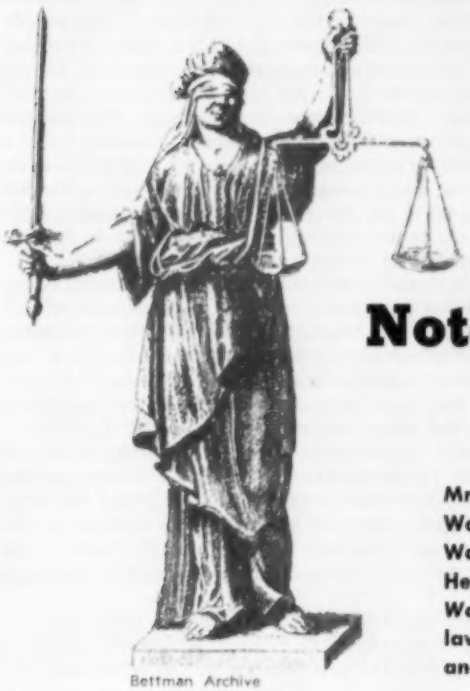
In the new plant, water from the two raw water sources enters the dosing chambers separately and can be treated separately to the point of final lime application immediately ahead of the finished water reservoir. Also, the two waters may be blended in the mixing chamber, which is equipped with vertical vane type rapid mixers. After leaving the dosing and mixing chambers the water flows through a flume leading to the four flocculating and sedimentation basins. The sedimentation basins are equipped with continuous sludge removers.

The effluent of the sedimentation basins flows through a series of flumes into the old and new filter buildings, where the water is filtered and then pumped into ground storage tanks by an automatic pumping station. Both the old and new filters are equipped with surface wash units of the rotary type.

Before construction of the new basins was begun the walking-beam flocculator equipment in the two old basins was inspected and found to be in excellent condition after approximately seven years of service. Since these flocculators could be adapted easily for use in two of the new rectangular basins, it was decided to equip the other two basins with the same type of walking-beam flocculators. The old flocculators and basins were kept in operation until two new basins were ready to be put into service. Both the old and new flocculating equipment has now been in continuous operation several years and has required little maintenance other than lubrication. Since all bearings and drive mechanisms are above water, this operation is a simple and positive one.

The overall expansion program required approximately four years to complete. During this transition period many operational problems arose. The present nominal capacity of the Norfolk water system is 48 mgd. During the summer of 1954, however, peaks in excess of 52 mgd were reached.

Trial runs have demonstrated that the purification facilities may be efficiently operated at a 25 percent overload. During emergencies the Moores Bridges plant has been operated at a 50 percent overload for short periods. Such overloads were not possible before the installation of modern chemical feed and mechanical flocculation equipment to condition the water properly for filtration and, thereby, maintain high filter efficiencies.



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Notes on Water Works Law

by JOHN H. MURDOCH, JR.

Mr. Murdoch is Vice-President of American Water Works Co., Inc., and Chief Counsel of American Water Works Service Co., Inc., Philadelphia, Pa. He has prepared exclusively for *Water & Sewage Works* this series of articles discussing water works law as it applies to source of supply, water quality, and water distribution.

Fifth Installment—Water Works Liability for Furnishing Water Dangerous to Health

IN THE previous sections of these Notes consideration has been given to the law of riparian rights, stream pollution, irrigation, and water diversions. Beginning with this section the law regarding responsibility of water works for the quality of water furnished to consumers will be developed.

This section and the one to follow deal principally with liability for furnishing water dangerous to health. In later sections questions of law having to do with furnishing water unsatisfactory for other reasons and with the law regarding fluoridation, will be covered. Still later sections will deal with legal liabilities growing out of water distribution, particularly liability for damages due to flooding from broken mains and other facilities. A section will be given to liability for fire losses.

As a preliminary to the main portion of this section on liability for furnishing water which is dangerous to health, it is necessary to dispose of the question whether, in this connection, there is any distinction between municipally owned and privately owned water works. In brief, the answer is that there is no distinction.

The courts hold that *when a municipality undertakes to supply water for domestic, commercial and industrial uses, it acts in its proprietary capacity rather than in its governmental capacity and that in its proprietary capacity it is liable for the acts or failures of its servants, just as is a privately owned water company.*

The case of *Brush v. Commissioner of Internal Revenue*, 300 U.S. 352, decided March 15, 1937, is interesting because of its discussion of this point of law. The United States Supreme Court held that Mr. Brush was not liable for Federal income tax on his salary as chief engineer of the Water Department of New York City on the ground that in operating the water works the city was performing a governmental function. Later decisions had the effect of overruling this exemption of governmental salaries.

The court, in the Brush case, did recognize that the law of "most states" held that a municipality acted in a proprietary capacity in operating a water works and was liable for the negligence of its employees. The Brush case did not involve this point and, of course, did not change the state laws regarding it. A portion of the Supreme Court opinion is here quoted as showing that court's thought concerning the reason back of the state rule of law. From page 362 of 300 U.S. *(Brush v. Commissioner)*:

"There probably is no topic of the law in respect of which the decisions of the state courts are in greater conflict and confusion than that which deals with the differentiation between the governmental and corporate powers of municipal corporations. This condition of conflict and confusion is confined in the main to decisions relating to liability in tort for the negligence of officers and agents of the municipality. In that field no definite rule can be extracted from the decisions. It is true that in most of the state courts, including those in the state of New York, it is held that the operation of water works falls within the category of corporate activities; and the city's liability is affirmed in tort actions arising from negligence in such operation. But the rule in respect of such cases, as we pointed out in *Trenton v. New Jersey*, 262 U.S. 182, * * * has been 'applied to escape difficulties, in order that injustice may not result from the recognition of technical defenses based upon the governmental character of such corporation'; and the

"When a municipality undertakes to supply water it acts in its proprietary capacity rather than in a governmental capacity . . . it is liable for the acts or failures of its servants, just as is a privately owned water company."

rule is hopelessly indefinite, probably for that very reason."

In support of the statement that there is no distinction between municipal and privately owned water works as to responsibility for negligence in operation, the following authorities are cited:

McQuillin, "Municipal Corporations," Revised Vol. 6 (1936), Chap. 53, Sec. 2852, page 1194 ff—"It has been repeatedly held in the application of the well settled distinction between public and private functions, that the establishment and maintenance of a system of water supply in part for the use of inhabitants who pay for the necessity thus supplied is a commercial venture, and that for negligence in connection therewith the city or town is liable as a private corporation would be in performing a similar service."

City of Atlanta v. Blackmon, 179 South Eastern 842, Court of Appeals of Georgia, Division 2, decided April 22, 1935—"Under the rule in force in this state a municipality, in maintaining and operating a system of waterworks whereby it furnishes water to its residents for domestic and commercial purposes is engaged in a private, nongovernmental business, and is liable to one injured by an employee acting in the scope of his employment in connection with such business." Citing *City of Rome v. Justice*, 40 Ga. App. 196 and other cases.

Buono v. City of Boston, 194 N.E., 658, Supreme Judicial Court of Massachusetts, decided Feb. 28, 1935—No discussion of the general principle of liability of the city, but the city was held liable for damages due to negligence in operation of the water system.

McGinley v. City of Cherryvale, Supreme Court of Kansas, decided January 26, 1935, reported, 40 Pac (2nd) 377—From page 379, after citing several Kansas cases: "In every case the rule is applied that a municipality is liable the same as private parties where it is engaged in supplying its citizens with water for which it collects from the users the value of the same. The profit, benefits, and advantages which it takes from its citizens mark it as being done in a proprietary capacity, and it is then liable for the negligence of its employees to the same extent as a private corporation."

The city was held liable for the negligence of its water works superintendent in operating a city owned truck on his way to an out-of-the-city waterworks pump station, owned and operated by the city.

Rice v. City of Portland, Supreme Court of Oregon, decided February 9, 1932, reported 7 Pac. (2nd) 989—"In maintaining and operating its water system, the city was acting in a proprietary capacity and not as a governmental agency." (From page 990).

Buffum's v. City of Long Beach, District Court of Appeal, Third Circuit (California), decided January 26, 1931, reported 295 Pac. 540—The city was held liable for damages resulting from flooding from a broken main.

City of Richmond v. Virginia Bonded Warehouse Corporation, Supreme Court of Appeals of Virginia, decided June 16, 1927, reported 138 S.E. 503. From page 506—"A municipal corporation is not liable for the failure to exercise, or for the negligent or improper exercise of, governmental, legislative, or discretionary powers, nor is it liable for the ultra viris acts of its servants. But the failure to exercise, or for negligence in the exercise, of those powers and privileges which are conferred upon it for its private advantage, usually called proprietary or ministerial, the municipality is liable in the same manner as a private individual. * * *.

"It was also conceded that the organization and operation of a fire department for the extinguishment of fires is a governmental function, for the defects of negligent operation of which the municipality is not liable, and furthermore, that it is not liable for the loss or destruction of buildings because of an inadequate supply of water or for failure to extinguish fires. * * *.

"But the operation of a water department for the purpose of supplying water for domestic and commercial purposes is a private or proprietary right and for negligence in such operation a municipality is liable in like manner as an individual. The fact that the water is also used for the extinguishment of fires does not change the result. * * *"

The city was held liable for negligence in operation of valves in connection with a sprinkler system where the negligence resulted in a flooding of the warehouse.

Badten v. City of Stevens Point, Supreme Court of Wisconsin, decided November 9, 1932, reported 245 N.W. 130—The city was held liable for negligence in installing a water works service connection on the grounds that it was acting in a proprietary capacity in operating its water works.

Liability for Supplying Water Dangerous to Health

Recovery of damages against a water works because water dangerous to health reached consumers through water works mains might be sought either on the ground of negligence or for breach of an implied warranty that the water was safe for human consumption; that is, by a suit for breach of contract. The first alternative will be the subject of this section. It is necessary at this point to define "negligence" and some other terms that are often used by the courts in opinions touching on negligence.

Negligence: "The failure to observe, for the protection of the interests of another person, that degree of care, precaution, and vigilance which the circumstances justly demand, whereby such other person suffers injury." (Cooley on Torts). Negligence is also defined as "Any conduct which falls below the standard established by law for the protection of others against unreasonable risk of harm."

Standard of conduct established by law: The standard of conduct to which one must conform to avoid being negligent is that of a reasonable man under like circumstances.

Reasonable man: Reasonable man is a person exercising those qualities of attention, knowledge, intelligence and judgment which society requires of its members for the protection of their own interests and the interests of others.

Unreasonable risk: A risk which outweighs the value attached to the conduct which involves it. Illustration: A high-pressure pipeline in a busy street may burst and cause damage. To operate such a pipeline therefore in-

volves a risk. Its social value outweighs this risk and the placing of it is not conduct involving an *unreasonable risk.* The storing of nitroglycerine in a schoolhouse would be conduct involving unreasonable risk.

Negligent conduct: May be either (a) an act which the actor as a reasonable man should realize involves an unreasonable risk of causing an invasion of an interest of another, or (b) a failure to do an act which is necessary for the protection or assistance of another and which the actor is under a duty to do.

When, on principle, is a water works operator negligent? From the definition this conclusion can be stated: A water works operator is negligent when his conduct brings an unreasonable risk of harm to his consumers or to persons or property of others, and when his conduct is not up to that standard of conduct recognized by water works operators generally as required under like circumstances to protect from unreasonable risk others to whom a duty is owed. Each operator is judged by a standard established by good practice and standards of good practice for water works are established by the consensus of experienced, trained water works men.

Some Legal Principles

Before there is a legal liability for damages in negligence cases certain elements must be present. A statement of these elements is needed, as follows:

First: Damages must have been suffered by some person.

Second: This other person must be one to whom the actor owes a duty of protection or assistance.

Third: The actor must have done or failed to do some act.

Fourth: This action or failure to act must have caused the damage.

Fifth: The action or failure to act must have involved an unreasonable risk to others.

Sixth: The action or failure to act must not have measured up to the standard of good practice under the circumstances.

Seventh: The failure to act must have been a failure to act in a way in which the actor was under a duty to do.

In short, before there is a legal liability for damages for negligence there must be negligent conduct resulting in damage to a third person to whom a duty is owed.

There can be no question that water works operators owe to water consumers the duty to use all practicable means to supply water safe for human consumption. If, through the acts or omissions of a water works organization—acts or omissions which would not measure up to the standards fixed by qualified water works men—water unfit for human consumption is delivered to consumers and damage results, the water works is liable for damages on the ground of negligence.

As the sciences and arts involved in water purification, bacteriology, water treatment, sewage disposal and stream cleanup have advanced, the standards of acceptable water works practices have advanced. What was considered the conduct of a "reasonable man" in water works operation in the 1890's and early 1900's seems, by present day standards, to be below barbaric levels. To show how acceptable practices have changed with advancing knowledge, as well as to show how the law has developed, some illustrative cases are given.

Buckingham vs. Plymouth Water Company, Pennsylvania Supreme Court, May 4, 1891, 142 Pa. 221. Appeal by Buckingham from Court of Common Pleas of Luzerne County. The judgment of that court was affirmed. The lower court had granted a nonsuit in an action against a water company for negligence in supplying impure water to its consumers. It was alleged that the supplying of impure water resulted in the death of Buckingham's children from typhoid. The court ordered a nonsuit on the ground that there was no evidence of *culpable* negligence on the part of the water company which could be submitted to the jury. The court held that an offer to show that, before the sickness of the children, there were typhoid fever patients near the banks of small streams emptying into a river from half a mile to a mile and three quarters above the company's river intake, *did not tend to establish negligence.*

Portions of the lower court opinion are quoted because of their historical interest as showing how far we have progressed in guarding against typhoid contamination of public water supplies. With our present state of knowledge and with presently available means of maintaining the purity of water, the same facts as developed in this case would now be sufficient to sustain a verdict in favor of the plaintiff. The following excerpts are quoted from the published report of the case cited:

"The principal source of supply was a stream called Coal Street Creek, coming from the mountain back of the borough. Upon this stream, four dams were built for reservoirs, and an artesian well was also put down near it, between dams No. 1 and No. 2. In dry periods the supply was insufficient, and to supplement it, the company ran a supply pipe into the Susquehanna River, through which water was pumped into the distributing reservoirs.

"In the fall of 1884 and the following winter, cases of typhoid fever began to occur in Plymouth. Towards spring it became epidemic. There was a population of from 7,000 to 8,000 supplied with water by the defendent company, and among that number there were about 1,200 cases of sickness. In April, 1885, five or six children of plaintiff had the typhoid fever and that two of them died. It was made to appear in the testimony that two small streams, one called Toby's Creek, the other Whitewash Creek, emptied into the Susquehanna, one of them about 2,800 feet above the intake of the water company, and the other about a mile and three quarters above said point. These streams come in on the west side of the river, and it was shown that the mouth of the supply pipe was about 220 feet from the west bank. It

"A water works operator is negligent when his conduct brings an unreasonable risk of harm to his consumers or to persons or property of others, and when his conduct is not up to that standard of conduct recognized by water works operators generally as required under like circumstances to protect from unreasonable risk others to whom a duty is owed. Each operator is judged by a standard established by good practice and standards of good practice for water works are established by the consensus of experienced, trained water works men."

was claimed by the plaintiff that the waters of both these streams were contaminated by sewage. There was evidence, also, that in January, 1885, there was a typhoid fever patient in a house on the bank of Coal Street Creek, whereon the reservoirs of the defendant company were situated; and that the excreta of this patient were thrown out upon the snow, and when the snow melted away, were carried into the stream and into the company's reservoirs. * * *

"Plaintiff proposed to show that along the banks of Toby's Creek and the tributaries to Toby's Creek, during the winter previous to the breaking out of this epidemic in Plymouth, Dr. Corse had typhoid fever patients, the dejecta from whom went right into Toby's Creek and into the river above where the Plymouth Water Company got their water supply; to be followed by evidence that the Plymouth Water Company took water from the river at a point below certain streams, Whitewash Creek and Toby's Creek, among others, which emptied into the river a short distance above where they took their supply, and were infected with typhoid fever germs. Plaintiff proposed to show, further, such a prevalence of typhoid fever on these tributaries, and such a condition of dejecta flowing into those streams that emptied into the river just above where the Plymouth Water Company took their water out, as would put any reasonable person upon guard and care to avoid the danger resulting from this condition of affairs. * * *

"This action is against the Plymouth Water Company, for negligence, which, under the law, means want of ordinary care. They are liable, if at all, because they have been guilty of the want of ordinary care under the circumstances of the case. Now, the proposition in this offer is to show that they took water from the Susquehanna River and distributed it to their customers in Plymouth; also, to show that at the time in question, on the branch of Toby's Creek or on Toby's Creek, there existed certain cases of typhoid fever; that the excreta or dejecta from these patients, because of the nearness of the privies, as I understand it, to the stream, were carried down this creek to the Susquehanna River, and emptied into it, at a point a mile or a mile and a half above where the Plymouth Water Company took their water. The further proposition in the offer is to show that the company would, in law, be affected by constructive notice, first, of the fact that typhoid fever existed on this tributary of the Susquehanna River; second, that excrement or dejecta from the patients of this fever, went into the stream or creek; and third, and necessarily, that these dejecta or excreta would naturally be the cause of typhoid fever to parties who drank the water from the Susquehanna River below the point where the stream empties into it. The proposition is to show that the company must have constructive notice of all these facts, and therefore that they did not exercise ordinary care, under the circumstances, in distributing to their customers water from this source of supply. No such proposition has ever been made in any reported case I have ever read. We do not regard it as competent evidence, under the circumstances of this case, to establish negligence. The objection to the offer is sustained; exception. * * *

"Various offers by the plaintiff to prove the opinions and theories of medical experts as to the cause of the epidemic of typhoid fever, were also refused, under objections and exceptions sealed. * * *

"Let us briefly recapitulate the facts in this case:

"1. The disease which caused the death of two of the plaintiff's children, and the sickness of others, was typhoid fever, produced by drinking the water drawn from the supply pipes of the defendant. * * *

"3. The evidence in the case does not show that the defendant company had any notice or knowledge of the fact that a case of typhoid fever existed in the house referred to, or of the fact that the dejecta had been thrown out upon the ground near the bed of the stream, or of the fact that typhoid fever is produced by a specific typhoid germ existing in the excreta of a person sick with that disease, which, being deposited in a stream, multiplies so that it contaminates the body of the water and reproduces the disease in the persons who drink it. Nor does the evidence show that the defendants owned or in any way controlled the property upon which the case of typhoid fever referred to occurred.

"4. The evidence does show that the superintendent of the company, from time to time, went along the banks of the stream, for the purpose of examining its condition, and that he had made such an examination a few days before the epidemic appeared, finding nothing to suggest a danger of contamination of the water.

"Finally, in view of the facts thus established by the evidence in the case, we deem it our duty to hold that the plaintiff has not shown that the sickness of his children was caused by the negligence of the defendants. The motion for a compulsory nonsuit is granted."

Peffer v. Pennsylvania Water Company, 221 Pa. 578. Appeal to Supreme Court of Pennsylvania from a decree of the Court of Common Pleas of Allegheny County dated September 28, 1907. The lower court ordered the water company to "secure and provide and at all times hereafter furnish to the plaintiffs and its other patrons, either by change of its source of supply, by proper filtration, or by some other proper method, a sufficient supply of water, so free from sewage and organic matter, turbidity and odor as to make said water reasonably pure and wholesome." The Supreme Court affirmed the decree of the lower court.

From the opinion of the lower court we learn certain facts which are of interest as showing the nature of the water supply for a large metropolitan district as late as 1907. The supply was taken from the Allegheny River just above the city limits of Pittsburgh. The water was drawn through cribs in the bed of the river, the cribs being filled with gravel and sand. No other filters were used and the water was not treated in any way. Incidentally, the City of Pittsburgh also used the same river as its source and had no filter plant until about the same period.

"8. The water shed draining into the Allegheny River at this point covers about 12,000 square miles. It extends

east as far as Johnstown on the Conemaugh River, and north beyond Oil City on the Allegheny River, and includes a large number of towns and a thickly populated district. A short distance above these cribs the sewage from the Allegheny county workhouse and the Allegheny city poor farm empties into the Allegheny River with a volume of 188 gallons per minute; at Oakmont, two and a half miles above, 107 gallons of sewage per minute; at Verona, still nearer the defendant's cribs, with sewage of 220 gallons per minute.

"Taking into consideration the extent of the watershed, the territory draining into the Allegheny River, the sewage from towns, villages, cities, public institutions, and the presence of bacteria and coli in the analysis of the raw Allegheny River water, compels the finding as a fact that at the place in question, to wit: the cribs of the defendant company, the Allegheny River is a highly polluted stream.

"9. In 1905 and 1906, typhoid fever, which was prevalent since 1902 in the borough of Wilkinsburg, became an epidemic; it also prevailed to a great extent in the Thirty-Seventh Ward, Pittsburgh, and in Swissvale Borough, supplied by the defendant company, the percentage of cases and the death rate being higher per thousand capita in Wilkinsburg than anywhere else in the United States; these typhoid cases were generally distributed throughout the two boroughs and the ward above referred to.

"10. While modern scientific opinion is that typhoid fever may be caused and spread by vegetables, milk, infection, etc., a careful consideration of the large mass of expert testimony given by the witnesses on both sides in this case justifies the finding as a fact that impure, polluted water, containing bacteria and the colon bacilli, is a prevailing cause of this pestilence.

"11. From the great number of bacterial analyses made by the various experts for both the plaintiffs and the defendant, it appears that bacteria in large numbers exist in the raw Allegheny River water, averaging many thousand per cubic centimeter. It also appears that the quantity of bacteria found in this water after it passes through the filter cribs of the defendant company is very materially reduced when the cribs, pipes and coverings were in perfect condition, and when the scouring process was not going on.

"These analyses also show the presence of colon bacilli in proportionately large quantities in the raw Allegheny River water; their presence is very materially reduced after the water has passed through the filter cribs when they were properly used, in proper repair, and the scouring process was not in operation, but both bacteria and the colon bacilli in dangerous quantities are found in defendant's water after it has passed from the filter cribs.

"12. From all the testimony, taking into account the source and character of supply, the effect and amount of contamination and pollution, the presence of bacteria and coli, its turbidity and odor, the prevalence of typhoid fever, the method of increasing the supply while lessening the efficiency of the filter process, the accidents which have occurred since the cribs have been in operation, the inability of the defendant company to continuously examine and repair these cribs, the fact is found that the water furnished by the defendant company is not reasonably pure and wholesome, and that without a change and improvement of its present filtration processes, it cannot furnish reasonably pure and wholesome water."

The opinion of the lower court contains a statement of law concerning a standard for water quality as follows: "It may be taken as settled at the outstart that chemically pure water is not the standard. The definition of the water required, that it shall be ordinarily and reasonably pure and wholesome, * * * necessarily means that such as is reasonably clean from dirt, discoloration and odor, reasonably free from bacteria and coli, or any other infection or contamination which renders the water unfit for domestic use and unsafe and dangerous to individuals. Modern investigation and scientific attainments demonstrate that water from polluted sources can by proper filtration be made reasonably safe and pure, and therefore the standard of purity as fixed by the well-recognized authorities must be secured."

A judge today would probably word the standard a little differently. By improved methods, water works engineering and chemists have raised the standards.

Gosser v. Ohio Valley Water Company, 244 Pa. 59, Opinion Feb. 9, 1914—The water company drew its supply from wells on an island in the Ohio River below Pittsburgh. The water filtered into the wells through several feet of sand and rock. The river water was contaminated by sewage but there was no direct testimony that it contained typhoid fever germs or that there were typhoid fever patients within the watershed. On January 15, 1909, the river stage was so low that company officials feared the supply from the wells would be insufficient and caused water to be pumped directly from the river into its receiving cistern. The pumping continued for twelve hours and during that period three-tenths of the water that went into the cistern came directly from the river. The plaintiff's husband died of typhoid. There was no direct positive testimony that he had drunk any water served by the water company. He was a traveling man and drank water from many sources. The lower court gave binding instructions for the defendant water company and the Pennsylvania Supreme Court affirmed.

Kohlmeyer v. Ohio Valley Water Company, 58 Pa. Superior Court, 63, Opinion July 15, 1914. Same attorneys for both parties as in Gosser case. Same facts as to source and as to direct pumping from river. Here there was proof that the river water was unfit for human consumption. The day after the company pumped water from the river a child of the plaintiff's drank water furnished by the company and later died of enteritis. There was a verdict for the plaintiff on which judgment was entered. The Superior Court affirmed. The court said (page 68 of the report): "It is true that no evidence was offered to show that the water in plaintiff's house contained a specific germ which necessarily produced the sickness, but in view of the well-known relation of impure water to health and the effect of sewage on the wholesomeness of water and the testimony of the expert witnesses as to the reasonable cause of the disease from which the child died such demonstrative evidence ought not to be required. If conclusions are to be drawn in judicial investigations only from evidence which excludes all possibility of error the field of legal inquiry must be greatly limited. Absolute certainty cannot be expected nor required."

In the next installment of these Notes on Water Works Law more recent cases on negligence of water works in furnishing water dangerous to health will be considered. There will also be some discussion of the rule of evidence of negligence known as res ipsa loquitur and of implied warranty.

(The fifth in a series of articles)

W&SW

Storage for Large Maps and Plans

by DORA H. PARKER
Draftsman, Alabama Dept. of Public Health, Montgomery, Ala.

ALTHOUGH the matter of storing the accumulating volume of records of smaller dimensions has been eased somewhat by microfilming, storage of larger records, such as maps and plans, presents a problem in proportion to their size.

A particular problem of storage for water and sewer plans for the various Alabama cities and towns arose recently when the Bureau of Sanitation of the State Health Department moved into quarters in the New State Office Building in Montgomery, Ala.

The plans, representing the accumulation over the years for each city and town of Alabama, must be kept intact from the first record of installation to the latest proposed addition, because approval of proposed additions and extensions to any plant requires that the total picture of each system must be available for review at all times.

The plans are approximately 30 inches by 42 inches and consist of from 1 to 25 or 30 sheets per plan. The total space required for storing the current file of some 7,000 sheets of permanent records, plus the normal yearly increase of plans approved by the State Health Department, was the first consideration in approaching the problem. The second consideration was to design storage that would provide adequate space and be easily accessible for filing and reference. There also was the more practical aspect of keeping the cost down by not using special fittings.

Considerable thought and discussion on the matter resulted in the design described herein. The result has been eminently satisfactory and this facility is suggested to those who might have a similar problem of storage for large permanent maps and records. The device is particularly adaptable due to its construction from readily available stock supplies.

Construction of Rack

The entire wall of a storage room was used to build the two-deck rack (Fig. 1) from which the plans were hung. The rack was built in place with 2x4's, the three lengthwise pieces forming the top framework of each deck being placed on edge for strength. The wall being approximately 18 feet long, three supports with diagonal braces were placed at approximately 4-foot 2-inch intervals for added strength. A base built to conform to the rack dimensions was laid flat and bolted to support the structure.

FIG. 1 — CURTAIN RODS provide convenient and space-saving storage for large plans

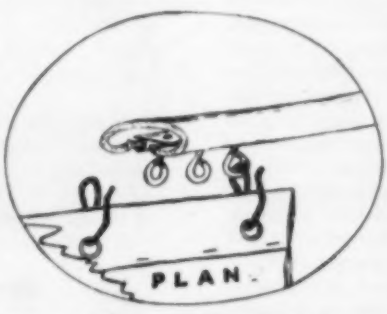


FIG. 2—DETAIL of track and hooks

The back and top are covered with ⅛-inch masonite. Four sets of sliding doors complete the compartments.

For hanging the plans, 30-inch lengths of Kirsch overhead tracks (heavy-duty drapery rods) with three slides for attaching the plans by means of drapery hooks were set on 1-inch centers and fastened to the three overhead 2 x 4's by means of screws. The ends of the tracks were crimped to retain the slides.

This arrangement provides 50 tracks in each of the four upper and lower compartments, or a total of 400 tracks.

The plans are indexed numerically and alphabetically, then grouped as nearly as possible according to city and plant identification. The thickness of each group of plans is kept to a maximum of approximately ¾ inch.

They are then bound with 3-inch heavy manila gummed tape. Three brass eyelets through the bound edge 2 inches from each end and at the center permit drapery hooks to be inserted in each eyelet.

The plans are then ready to file. This is done by simply inserting the hooks into the projecting swivel loops of the slides, beginning with the back hook into the back loop (see Fig. 2).

Plans can thus be filed or withdrawn easily by either inserting the hooks or disconnecting the hooks from the slide loops one at a time and inserting or withdrawing the plans, as the case may be. The crimped ends of the track retains the slides and the hooks remain attached to the plans.

Its economy of construction and its ease of operation commend this storage scheme to those who need this type of storage.

Acknowledgments

Acknowledgment is made to the following who contributed largely in the design of the plans through suggestions, questions and encouragement: C. W. White, Assistant Sanitary Engineer; R. V. Barnes, Assistant Sanitary Engineer; W. H. Gilmore, Assistant Sanitary Engineer; Joe L. Crockett, Jr., Assistant Sanitary Engineer; and Arthur N. Beck, Chief Engineer and Director, who approved the plans and directed the installation.

1955 AWWA Chicago Conference

3—Digests of Papers

The general story of the conference was published in the August issue and technical digests of the Water Purification Division papers were published in the September issue of W&SW.

AN ENTIRE session of the 1955 AWWA Conference, held in Chicago June 12-17, was devoted to papers of the Joint Boiler Feedwater Research Committee. Activities of the Water Resources Division occupied three sessions.

Boiler Feedwater Problems

At the Boiler Feedwater Committee session, papers were presented as follows:

"Merits, Defects and Performance of Monobed and Two-Bed Demineralizing Systems," were described by H. E. Bacon, L. G. Von Lossberg and Sheppard T. Powell, Consulting Engineers, Baltimore, Md. These authors report that mixed-bed ion exchangers may show interference by reason of iron, manganese or organic fouling, so the iron and manganese should be removed before the softening process. With both high bicarbonate and high sulfate waters, sodium content of the effluent is low, effluent silica content is low, and effluent solids are highly solubilized. Automatic regeneration can be accomplished by means of fixed flows, set times, or a valve set diagram.

Instrumental defects are a source of trouble. Operating difficulties arise from loss of capacity of strongly basic ion exchangers, unscheduled instrument impulses due to vibration, missing of impulses due to dust or dirt, false high-conductivity readings due to stagnant areas in the instrument connections or exchange units, and fluctuating caustic solution temperatures and concentrations. Another major cause of difficulty is non-reproducibility of acid and alkali charges. Pipeline mixing of regenerants is much used, but batch mixing is preferred. Hot caustic regenerant picks up iron from pipes and tanks and causes rubber linings to slough off. Other troubles are caused by leaks of water, acid and caustic.

Mechanical costs of operation often are reducible by regeneration at low concentration. Rinse is better in the one-bed system, however, because of multiple use of the exchanger.

"Suspended Solids—Their Identification, Significance and Control," was presented by S. K. Adkins and B. J. Wachter, both of the Boiler Feedwater Technical Service, National Aluminate Corp., Chicago. The authors discussed the part played by boiler water suspended solids in forming deposits. They pointed out that boiler water suspended solids may be both quantitatively and qualitatively predicted from the composition of the feedwater. Boiler water analysis can confirm the amounts of suspended material present. Gravimetric or x-ray analysis can specifically identify sludges and scales.

Knowing the properties of the specific constituents of the feedwater, one can discover what insoluble compounds these constituents are likely to form under operating conditions of the boiler. In addition, control of the method of formation of insoluble compounds can be established to minimize or eliminate adherent deposits.

Selection of chemical treatment programs to form suspended solids which are easily conditioned, nonadherent, and easily removed by blowdown is entirely possible, practical and economical.

"Corrosion Problems in Small Heating Boilers" were discussed by Howard F. Hinst, Chief Metallurgist, Keystone Plant, Babcock & Wilcox Co., Tubular Products Division, Alliance, Ohio. While the majority of low-pressure heating boilers operating at 15 psi steam and 30 psi water pressure perform satisfactorily without water treatment, a small percentage experience trouble with tube failures. Most of these are due to dissolved oxygen in the boiler water; others are due to fire-side attack by moisture in combination with the products of combustion of the fuel.

Water Resources Policy

At the first Water Resources Division session Paul Belcher, Vice-President, First National Bank, Akron, Ohio, described what has been done in "Regional Water Supply Planning for North Central Ohio."

Although Akron was given exclusive rights on the Cuyahoga River some 45 years ago and the river provides enough water for the city, it must be shared with other communities. Lake Erie may be tapped, but such a source involves many problems.

Current developments in "Our National Water Resources Policy" were then discussed by Clarence A. Davis, Under Secretary, U. S. Department of the Interior, Washington, D. C.

Water policies suggested recently by such bodies as Engineers Joint Council, the U. S. Bureau of Reclamation, the U. S. Chamber of Commerce and others may vary in detail, but all are in general over-all agreement. Many of the problems are local rather than national in scope. Flow control of river systems was originally thought to be the most important requirement. Now, however, recognition is given to the fact that adequate and clean water is more important than electricity and other power sources in the location of industries.

The Federal government should not enter the water supply field. In some instances, however, research is required at the national level; for example, the demineralization of sea water. Some $400,000 per year has been spent for research on this problem. Costs of present developments are still too high for widespread use, but have come within reasonable range for the limits of domestic use ($0.12 per 1000 gal. for operation and $0.12 for investment).

Any water policy adopted must be broad and comprehensive. Estimates of required expenditures run to $300 million per year for 10 years in the Columbia River basin; $150 million in the TVA; and $750 million per year for stream pollution control and abatement. These costs cannot and should not be borne by the Federal government alone; the municipalities involved generally have resources equal to those available at the national level.

"1955 State Legislation Concerning Water Resources," was then reviewed by a panel consisting of Stephen W. Bergen, Conservation Foundation, New York, N. Y.;

Charles H. Capen, Chief North Jersey District Water Supply Commission, Wanaque, N. J.; George S. Rawlins, Vice-President, J. N. Pease & Co., Charlotte, N. C.; Charles H. Bechert, Director, Indiana Department of Conservation, Indianapolis, Ind.; T. W. Thorpe, President, Thorpe Well Company, Des Moines, Iowa; Morrison B. Cunningham, Superintendent and Engineer, Water Department, Oklahoma City, Okla.; and Louis J. Alexander, Chief Engineer, Southern California Water Company, Los Angeles, Calif.

At the second Water Resources session "Development of a Fresh-Water Barrier in Southern California for the Prevention of Sea-Water Intrusion" was described by Finley B. Laverty, Chief Hydraulic Engineer, and Herbert A. van der Goot, Supervising Civil Engineer, Los Angeles County Flood Control District.

California allocated $750,000 in 1951 to find out what could be done to halt sea-water intrusion into coastal ground-water basins. To this end the Los Angeles County Flood Control District, because of past work in this field, was asked to plan and operate a series of injection wells in a pressure aquifer to stop the inland flow of sea water.

The discussion presented the geologic and hydraulic conditions encountered, the facilities installed, and their operation. It described the building of a pressure mound in an aquifer where the chloride concentration approached 18,000 ppm, and traced the movement of salt and fresh water inland.

"Recharge Operations of the Upjohn Company, Kalamazoo, Michigan," were described by W. H. Sisson, Construction Engineer of the company.

Water conservation was given much consideration in the design and construction of the 2,000,000-square foot manufacturing plant of the Upjohn Company, recently completed in Kalamazoo, Michigan. The average demand of 6.5 mgd of water is satisfied from wells. After flowing through air conditioning coils, approximately 50 percent of it is re-used for condenser water, vacuum stills, product cooling, and roof sprays. Some water is re-used for the fourth time in irrigating 22 acres of lawn. In 1954, after some experimenting, it was found possible to save more than 0.5 mgd by exhausting some vacuum jets directly to the atmosphere rather than condensing the vapors with water.

To further conserve water, although ground water is plentiful at the plant site, work was started in the fall of 1952 to determine if a recharge pond operation would be practical. A 10,000-square foot area of ground that could be filled by gravity with clean warm waste water was diked off; fourteen 2-inch observation wells were drilled in four directions and at various distances from the pond; an 8-inch filling line was installed and the area filled with 3 feet of water. Static water level and water temperature data from the pond and observation wells were tabulated daily for almost two years.

A percolation rate of 115,000 gpd was determined for the area. The average temperature of the waste water going into the pond was 73°F. Curves show the effect of the Michigan air temperature in cooling this body of water considerably before it percolates into the ground, as well as the conduction cooling effect of the earth on the water as it travels away from the pond. It was found that the water cooled to the normal 52°F ground water temperature at the rate of 1°F in 19 feet of travel. By observing the temperature curve crests at various distances from the pond, it was determined that the water was traveling underground at the rate of 1.75 feet per day.

By plotting the static water level readings from the observation wells on opposite sides of the pond, the resulting "inverted drawdown curve" indicated the slope of the water table. It was noted that the table sloped at a 0.1 percent grade toward the company's pumping wells ⅓ mile to the east, and at a 0.079 percent grade toward the city's pumping wells 2 miles to the north.

Inasmuch as the experimental pond proved that the recharged water was flowing back to the company's wells, that the water was again cooled to normal well water temperatures, and that the percolation rate was acceptable, it was decided to enlarge the pond in September 1954 to an area of 50,000 square feet.

A 90-acre pond area on another side of the plant property is used as a natural recharge area. The pond was handling 1.5 mgd, but until the fall of 1954 was badly polluted with wastes from the production of fine chemicals. During the summer of 1954, primary treatment facilities and two 1,500-foot deep brine strata rock disposal wells were installed to pump this strong waste into the ground safely away from the potable water.

With the natural pond recharging 16 percent of the water and the artificial pond recharging 9 percent, a total of 25 percent of the pumped well water is being returned to the earth.

"Stream Plus Wells Make Economical Industrial Supply," was the title of a paper presented by R. D. Wilson, Partner, Wilson & Anderson, Consulting Engineers, Champaign, Ill.

Mr. Wilson pointed out that water supply was the critical problem affecting the location of the $44,000,000 plant of National Petro-Chemicals Corp. near Tuscola in east-central Illinois. Although the nearby Kaskaskia River flow would be more than adequate if a large impounding reservoir could be built, the stream has a very flat gradient and provides drainage for farm lands that would be flooded by a low dam in the channel. Suitable storage on a side channel also would be impossible.

The nearest source for adequate ground water supply is in an area about 20 to 25 miles north of the preferred plant location. This source is in glacial deposits in the ancient Lower Teays Valley, where it passes southwesterly about 4 to 10 miles west of Champaign, Ill. However, the cost of building a water line such distance, purchasing and developing a well field, and operating it would be very high. Local opposition to the continuous draft of 5 to 7 mgd from this source, which serves Champaign, Urbana, and other Illinois communities, was a factor to be considered.

Fortunately, the Kaskaskia River has its headwaters in glacial moraines lying above the Teays Valley, and the stream channel passes through the area in which very good ground water test holes were drilled. The solution chosen for water supply for the National Petro plant was a combination of intercepted natural stream flow, with limited storage in an almost entirely artificial side-channel reservoir, and arrangement for pumping of well water into the stream channel about 25 miles upstream to supplement the dry-weather flow.

This arrangement provides water at very low construction and operating cost, and at the same time conserves ground water resources by using excess stream flow to the maximum possible extent. The stream channel functions satisfactorily as an aqueduct, showing only 10 to 15 percent transmission loss between wells and intake. The normal annual rest periods for the wells are expected to permit substantial recovery and avoid serious recession in the well field.

In a discussion by Clifford Fore, Assistant Treasurer, Industrial Water Supply Company, Mt. Vernon, Ill.,

it was pointed out that the operation of the dual water supply for the National Petro plant at Tuscola proved economical during a drought period in 1953-54. While natural river flow in seasons of low rainfall is generally from farm land drainage systems, this flow was reduced to zero in 1954 and the only source of water was from the wells some 25 miles upstream. The average normal annual stream flow is 59 mgd. The seasonal variation of runoff per month in this area ranges from 0.2 inches (15 mgd) to 1.6 inches (121 mgd).

Maintenance of the river channel by agreement with the drainage districts consists of annual weed and brush kill by spraying along the ditch bottoms and side slopes of river banks with a herbicide and dredging of the channel ditches comprising the joint drainage ditches at least once each 10 years.

At the Tuesday afternoon session of the Water Resources Division, a motion picture of construction of Miami's newest water supply line was shown. Then a symposium of three papers described experiences in "Controlled Draft from Reservoirs." Operations in the New York Metropolitan system were described by Edward J. Clark, Chief Engineer, Department of Water Supply, Gas and Electricity. Control curves are utilized fully and economy is constantly kept in mind by utilizing as much as possible high-level supplies requiring no pumping.

Operation of "An Industrial Water Supply Reservoir" was described by A. D. Henderson, Westbury, N. Y., and A. S. Toth, Assistant Vice-President, Hydrotechnic Corp., New York, N. Y. And industrial water supply may be required, at any time, to provide water in excess of its "dependable yield" to meet high production schedules at the lowest possible production cost. The method of controlled draft permits safe overdrafts for industrial needs, as it comprises a running inventory of available excess water in the reservoir. It utilizes a limitary curve to indicate the maximum permissible reservoir depletion through a cycle of emptying and refilling. To obtain reliable results, the limitary curve must be derived for the driest period of a long-term record. Having selected the critical runoff period and starting with a full reservoir, a uniform rate of withdrawal from the reservoir is calculated so that all the usable stored water is utilized just prior to the refilling season. The plotting of reservoir contents through the complete cycle results in the limitary curve.

The application of the limitary curve in providing a means for controlling drafts is simply to plot it along with the current reservoir operations curve on the same time basis. By comparing the reservoir contents indicated by the current operations curve with the corresponding amount shown by the limitary curve at any time, the excess available stored water may be determined. Any excess stored water can be safely used by industry as needed. In the event that both storage curves coincide, draft should be controlled at the rate used to derive the limitary curve until storage excess is again indicated. Reservoir operation by this method permits the maximum utilization of stored water year after year.

"Equating Surface and Underground Storage" was the title of a paper presented by Raymond A. Hill, Consulting Engineer, Los Angeles, Calif. The distinction was drawn by Mr. Hill between emergency and regulatory storage, with natural underground storage noted as affording excellent regulation that would not otherwise be possible or at least would be much more expensive. Even for emergency use, underground natural storage basins often may be more economical or more feasible than elevated storage or surface storage. In most cases pumping is required, but legal restrictions are based on the total annual pumpage rather than on short-term pumping rates.

"Water Management — Another Necessity in Modern Industry," was presented by K. S. Watson, Consultant in Water Management and Waste Control, General Electric Company, Schenectady, N. Y. He pointed out that preservation and protection of the nation's water resources is of vital importance. In the operation of industry, so much water is required that its cost becomes an item of consequence. Big industrial water consumers should adopt a water management program to preserve the vital resource, to take the first and most economical step toward simplifying their industrial wastes problem, and to realize the cost reduction benefits accruing from sound water usage. The fundamental steps to be taken in such a program include (a) evaluation of current consumption and cost conditions, (b) practice of sound water conservation throughout the plant, and (c) water re-use and recirculation wherever it can be justified.

Management Problems

"Electrical Reliability Requirements for the Water Plant," were discussed by E. O. Potthoff and N. L. Hadley, Industrial Engineering Section, General Electric Company. Among the primary factors stressed were those of providing multiple power sources, automatic system cutouts for isolation of trouble spots, duplicate feed lines within the plant, proper standby equipment or cutovers, careful design of mechanical and electrical control equipment, and provision for fast repair or replacement. Adequacy of records on and testing of equipment by competent personnel also were stressed.

"Selecting Adequate Electrical Switching Equipment" was discussed by Joel P. Kesler, Electrical Engineer, Black & Veatch, Kansas City, Mo. Although general familiarity with most electrical components employed by the water utility industry exists, there is one serious exception. Electrical switching equipment requirements, particularly in connection with its short-circuit handling ability, are often not understood, resulting in hazards. Inadequacy is more frequent, with consequently greater hazards, with older type 2400- and 4160-volt equipment than with low voltage equipment of similar age. Hazards are considerably greater where the switching equipment contains oil. It is seldom feasible to provide electrical switching equipment for problematical, long time, future requirements. In the selection of electrical switching equipment it is the supply system, rather than the connected load, that determines the short circuit rating.

O. B. Carlisle and J. L. Weeks, respectively Chief Water Works Engineer, Water Design Division, and Mechanical Engineer in Charge, Operating Division, Bureau of Water, Chicago, described the planning and construction involved in "Modernizing Chicago's Pumping Stations." The city's eleven pumping stations have an aggregate daily output of more than a billion gallons. In the modernization program for these stations an attempt is being made not only to obtain and install efficient and reliable equipment, but also to improve working and safety conditions for the operating and maintenance personnel.

"Progress in Tunnel Construction for Chicago's Central District Filtration Plant" was presented by George S. Salter, Chief Filtration Engr., Filtration Design Division, Chicago Bu-

reau of Water. The Chicago Central District filtration plant, now under construction, will be by far the world's largest such plant, having a rated capacity of 960 mgd, three times that of the South District filtration plant, which has been operated at rates exceeding 500 mgd.

The plant will occupy 44 acres and provide filtered water to 3,000,000 people in the Central and North Water Districts and the adjacent suburbs; the South District filtration plant now furnishes such water to the 1,350,000 people in the South Water District.

Approximately six miles of tunnel construction is required as part of the filtration plant project. This includes 1400 feet of 20-foot tunnel for a connection between the existing raw-water tunnels and the plant, and two major sections of 16-foot tunnel from the plant to the Chicago Avenue and Wilson Avenue water tunnels. These tunnels are about 2,000 and 29,000 feet in length, respectively. They are horseshoe-shaped sections in rock and vary in depth from 160 to 220 feet below lake level.

Extensive subsurface explorations were made covering the area where the plant and tunnels were to be built. These explorations included numerous borings through the overlaying clay and the use of a newly developed sonar device (furnished by the USGS) for determining the depth to rock.

Several connections will be required between the new tunnels and the existing tunnel system. This will require breaking into the Chicago Avenue and Lake Shore Shaft and making a tunnel connection to that shaft while maintaining the Chicago Avenue tunnel in operation, the subsequent installation of a bulkhead in that tunnel so as to permit the dewatering of the length of tunnel between the Dever Intake Crib and the Shore Shaft, and then making connections to both the new 20-foot connecting tunnel to the plant and the auxiliary 10-foot tunnel to the Carter Harrison Crib. It is expected that the new filtration plant project will be completed and placed in operation in 1960.

"A Forecast of Metropolitan Chicago's Water Needs," was presented by Louis R. Howson, Consulting Engineer, Chicago. Mr. Howson described the extensive and intensive studies necessary to projection of future water needs in such a widespread area of such complex industrial and residential makeup.

In a discussion of "Water Supply Industry Safety—U. S. Labor Department Survey," George R. McCormack, Chief, Special Studies Section, Branch of Industrial Hazards, Bureau of Labor Statistics, pointed out that over 3,100 water works in the United States cooperated with the Bureau of Labor Statistics in its special survey of work injuries in the water supply industry. Together, those utilities employed about 64,000 during 1953, approximately 55 percent of the industry's average employment.

Only once since World War II has the annual injury-frequency rate for the water supply industry been below 20. In 1946, the rate was 18.0; in 1953, it was 22.2. In contrast to that experience, injury-frequency rates in manufacturing and in construction have, generally, moved downward.

An estimated 5,300 workers in the industry suffered disabling injuries during 1953; 35 of these died as a result. The cost of injury-producing accidents during 1953 has been estimated at $12,500,000.

Publicly operated water works had a slightly higher injury-frequency rate (24.8) than privately operated utilities (23.5). However, this disparity was due to the greater proportion of hazardous construction work included in the former group. Water works serving small localities and those serving large cities achieved the best average injury-frequency rates; the worst average rate was reported by utilities serving cities with populations between 100,000 and 250,000.

Departmentally, only one type of activity—engineering and construction—had an injury-frequency rate above the industry average, but the outside commercial departments had a rate only a little better than average. The administrative and water purification departments had the best frequency rate averages. Injuries were most severe in meter shops and water purification departments.

In describing "A Successful Safety Program," John W. McFarland, General Manager of the East Bay Municipal Utility District, Oakland, California, pointed out that there is no shortcut or "cure-all" for accident prevention. Safety programs have to be planned, and geared to the size of the utility and the type of people in it. Top management must actively participate in and support the safety program, but each individual must be made to feel personally responsible for the safety of himself and his fellow workers. Regular inspections and new employee approaches are an absolute necessity.

The East Bay safety program reduced accident frequency from the water industry average of more than 20 per million man-hours in 1953, to 11.48 in the same year. In 1954 it dropped to 6.98, and in the 12 months ending May 1955 was down to 3.00. In 1954 an insurance dividend of $45,000 was received, followed by an 18 percent reduction in premium rate.

In "Modernizing the Management of Chicago's Water Department," J. W. Jardine, Commissioner of Water and Sewers, described an Operating Methods Section that analyzes and evaluates organization practices and operating methods and procedures on a continuous basis in an effort to improve them wherever possible. A specialized staff is used to obtain unbiased results and then prepare written manuals of standard operating practices for the various departmental activities. Periodic supplements are intended to continually bring these manuals up to date.

A complete reappraisal of the whole idea of public relations was presented by Joseph S. Rosapepe, Account Executive, Dudley, Anderson and Yutzy, New York City. Under the title "Getting Your Customers on Your Team Through Public Relations," Mr. Rosapepe pointed out that water works operators must change their own attitude toward the product they are selling. Water is a valuable commodity that costs money to gather, treat and distribute. Too many operators still confuse the idea of providing good service with the concept that furnishing water to customers is a service function rather than the sale of a commodity.

Water is even more essential than gas or electricity. There are substitutes for both of these utilities in case of emergency, but there is no substitute for water as a necessary commodity. In too many communities the customer is still referred to as the taxpayer. If the accent is placed on water as a commodity, however, the user will begin to consider himself as a customer and not a taxpayer where water is concerned.

Water systems everywhere can make work easier for themselves if they really believe that "silent service is not enough," particularly if they show that they themselves realize that water is a highly valuable commodity.

W&SW

WATER WORKS PRACTICES

Chemical Handling and Feeding - Part 3

The Twenty-fourth of a Series

by GEORGE E. SYMONS, Ph.D.
Dr. Symons is Consultant and Technical Editor, Larchmont, N. Y. In this series he discusses *Water Works Practices* in the form of short course lectures. These are designed to assist plant operators, students, and all who wish to review fundamentals in this field.

PART 1* of this lecture dealt with the use, characteristics and handling of chemicals used in water works. Part 2 was devoted to chemical feeders. This installment (Part 3) deals with chemical feeding practices.

A . . . Chemical Feeding

1 . . DEFINITIONS

a. *Dosage* is the amount of chemical required to produce the reaction desired, expressed in terms of concentration of the chemical in the liquid undergoing treatment. Dosage is expressed in two ways.

(1) Parts per million by weight (ppm).

(2) Pounds per million gallons (lb per mil gal).

(3) Since parts per million are measurements by weight, and since one gallon of water (at normal temperatures) weighs 8.34 lb, therefore 1.0 ppm = 8.345 lb per mil gal.

(Ed. Note: In England, Canada and other British countries the imperial gallon weighs 10 lb. Consequently 1 ppm = 10 lb per mil gal.)

. . . An older system of dosage measurements (now out dated) was that which used grains per gallon (gpg). Grains per gallon multiplied by 17.1 equal parts per million.

b. *Feed Rate* is the amount of chemical added to the water undergoing treatment, expressed in the rate of addition per unit time.

(1) Feed rate is usually expressed in pounds per hour (lb per hr) or pounds per day (lb per 24 hr).

(2) Feed rate is an important factor in chemical feeding because chemical feeder capacities are rated on this basis of lb per 24 hr.

(3) Since the volume of liquid treated depends on the length of time of treatment and the rate of liquid flow, there must be a relation between flow, time, dosage and feed rate.

. . . This relation is expressed by the equation Feed rate (lb/24 hr)=

Dosage (ppm) × Flow (mgd) × 8.34

. . . Where chemical feeders are rated in the metric system, the relation between dosage, flow and feed rate is simpler to calculate since all items are expressed in the same system.

c. *Solution Strength* refers to the concentration of chemical in the solution as it is discharged into the water to be treated. There are several ways of expressing solution strength.

(1) For laboratory solutions, strength, or concentration, may be expressed in terms of ppm or milligrams per liter (mg per L).

(2) In operating practice, it is more common to express solution strength in terms of pounds of chemical per gallon of solution (lb per gal).

. . . This system has the added advantage of being usable for true solutions, mixtures of solutions and suspensions, and true suspensions, that is for soluble, partly soluble, and insoluble substances.

(3) Some water works operators refer to solution strength in terms of "per cent solution." This practice can be quite misleading unless the calculation is made properly.

. . . The proper method of calculating "per cent solution" for 1.0 lb per gal of water is as follows:

$$\left(\frac{1.0}{1.0+8.34}\right) \times 100 = 10.7\% \text{ solution}$$

. . . Table 1 shows the number of pounds to be added to one gallon of water to obtain various per cent solutions. Figure 1 shows these data plotted to make it possible to pick off other values and relations.

TABLE 1
Per Cent Solution Data

% Soln.	lb/gal	% Soln.	lb/gal
1.0	0.084	6.0	0.533
2.0	0.170	7.0	0.629
3.0	0.258	8.0	0.726
4.0	0.348	9.0	0.825
5.0	0.440	10.0	0.928

2 . . COAGULATION

a. Control Tests.

(1) Laboratory control is essential to proper coagulation because waters requiring coagulation are usually subject to wide variations in characteristics and because the best and most economical treatment can not be calculated but must be determined by coagulation control tests, commonly called "Jar Tests."

(2) Complete details for "Jar Test Procedures" (including equipment, techniques, and records) are given in Keep Sheet No. 26 of B-I-F Industries, Inc.

b. Aluminum Sulfate (Filter Alum).

(1) Types of feeders used:

. . . Gravimetric Loss-in-Weight for rates of 10 to 500 lb per hr.

. . . Belt-type gravimetric for rates of 50 to 5000 lb per hr.

. . . Volumetric feeders for rates of 1.0 lb per hr, up.

. . . Solution feeders are used sometimes in small plants.

(2) Dissolving.

. . . General practice is to use approximately a 6 per cent solution (0.5

* Part 1 appeared in the July issue; Part 2 in the September issue.

lb per gal) of alum leaving the dissolving chamber of the feeder.

. . . Some operators prefer a 3 per cent solution.

. . . At 120° F, it requires one minute to dissolve 0.5 lb of ground alum in a gallon of water with constant agitation.—At 35 to 45° C, it requires three minutes.

(3) Where solution feeders are used, a separate dissolving tank, with agitation, is necessary to dissolve the alum prior to use.

c. Liquid Alum.

(1) Usual grades and strengths of liquid alum are:

Deg. Baumé	Al_2O_3
27.0°	5.8%
32.2°	7.2%
36.4°	8.3%

(2) Types of Feeders.

. . . Solution feeders of decanter, orifice or rotameter type.

. . . Positive displacement feeders of the rotating dipper type or proportioning pump.

(3) Dilution.

. . . Dilute solutions are more effective than concentrated solutions, therefore liquid alum should be diluted before being fed to the water under treatment.

. . . To dilute liquid alum (7.2 per cent Al_2O_3) to the equivalent of a 3 per cent solution of dry alum (AWWA Specs.) add:

13.1 lb of water to each lb of liquid alum;
or,
16.8 gal of water to each gal of liquid alum.

(4) To convert dry filter alum dosage (AWWA Specs) to liquid alum dosage, multiply dry alum requirements by these factors:

Deg. Baumé	Factor
27.0°	2.93
32.2°	2.36
36.4°	2.05

(5) Liquid alum will crystallize on cooling to critical temperatures, depending on the concentration of the alum solution.

d. Chlorinated Copperas.

(1) Chlorinated copperas (ferric sulfate-ferric chloride) is produced by the action of chlorine on a solution of ferrous sulfate. Waste pickle liquor from steel mills may be used. In either case, a chlorine feeder and a solution feeder for the ferrous sulfate solution is required.

(2) Type of Feeder — Solution feeders of any type.

e. Ferric Chloride.

(1) Types of feeders.

. . . Dry feeders cannot be used because all solid forms of ferric chloride are deliquescent and form a syrup from atmospheric moisture.

. . . Orifice type solution feeders are not recommended because of varying viscosity and specific gravity of feric chloride solutions with change in temperature.

. . . Positive displacement solution type feeders should be used.

(2) Dissolving.

. . . Solution tanks should be large enough for one shift, at least, preferably for three shifts.

. . . Anhydrous ferric chloride has a high heat of solution; the temperature rise is 3.75 deg F for each one per cent solution. Crystal ferric chloride has a lower heat of solution.

. . . Simple method of dissolving of ferric chloride in metal drums—punch holes in top and bottom of can, insert hose and let water trickle through the can to solution tank below. When the can is empty, add water to solution tank to make up the desired strength.

f. Ferric Sulfate.

(1) Types of feeders.

. . . Gravimetric loss-in-weight feeders for rates of 10 to 500 lb per hr.

. . . Volumetric feeders for rates of 2 lb per hr and up.

. . . Solution feeders of all types.

(2) Dissolving.

. . . Commercial ferric sulfates are partially hydrated and do not become "gummy" on dissolving and do not evolve much heat, but agitation is necessary during dissolving.

. . . Dissolving temperatures are usually below 120° F; if a 2 to 1 ratio (lb water to lb chemical) is used, the dissolving time will range from 15 min for 40° to 5 min for 80° F water.

. . . Insolubles must be removed from the dissolving chamber. For solution feeders, separate dissolving chambers are required.

g. Ferrous Sulfate.

(1) Ferrous sulfate is used only when an alkali is added to produce the necessary pH condition to precipitate the hydroxide.

(2) Types of feeders.

. . . Gravimetric loss-in-weight feeders for rates up to 2000 lb per hr.

. . . Belt gravimetric feeders for rates up to 10,000 lb per hr.

. . . Volumetric dry feeders for rates up to 6000 lb per hr.

(3) Dissolving.

. . . Use 0.5 lb of chemical per gal of solution and provide a dissolving chamber of size to provide detention time of at least 5 minutes.

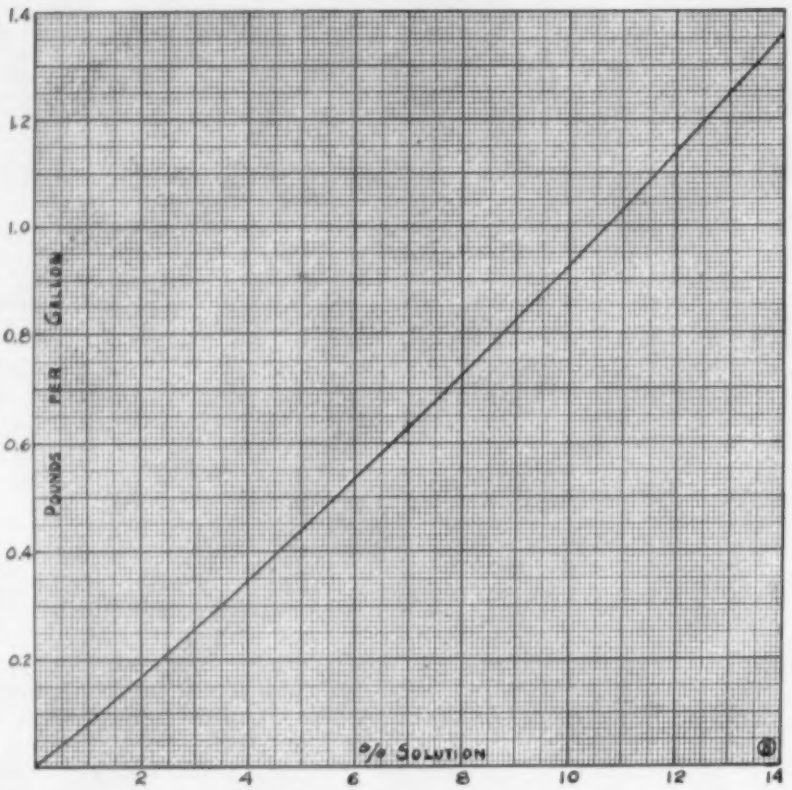


Fig. 1—Relation of pounds of chemical per gallon to percent solution.

h. Lime.

(1) Lime is used in coagulation when needed to produce alkalinity and a desired high pH.

(2) Types of feeders.

. . . If quicklime is used, gravimetric loss-in-weight feeders are used for rates up to 2000 lb per hr; belt gravimetric feeders up to 10,000 lb per hr; volumetric dry feeders for rates up to 6000 lb per hr. A slaker must be used.

. . . If hydrated lime is used, gravimetric loss-in-weight feeders are used for rates from 1 to 500 lb per hr; belt gravimetric feeders for rates from 50 to 2000 lb per hr.

. . . Volumetric feeders may be used for either quick or hydrated lime but in any case the lime slurry formed must be kept in suspension.

. . . Solution feeders of the rotating dipper type.

(3) Dissolving.

. . . If quicklime is used, add 2 lb of lime per gal of water in the slaking ratio and dilute the slurry to 0.93 lb per gal (10 per cent suspension), for feeding.

. . . If hydrated lime is used, add 0.5 lb per gallon as a maximum when feeding with dry feed machines, or for a slurry use a 10 per cent suspension.

i. Sodium Aluminate.

(1) Types of feeders.

. . . Gravimetric loss-in-weight dry feeders for rates up to 2000 lb per hr.

. . . Belt type gravimetric feeders for feeding rates up to 10,000 lb per hr.

. . . Volumetric feeders can be used for rates up to 6000 lb per hr.

. . . Solution feeders may be used if the chemical is dissolved in a separate tank.

(2) Dissolving.

. . . Feed at 0.5 lb per gal when using dry feeders.

. . . Higher strengths may be used when solution feeders are employed.

j. Activated Silica.

(1) Activated silica is a coagulant aid prepared by the activation of sodium silicate with some activating agent. Activated silica may be prepared by batch system and stored or it may be prepared continuously as used.

(2) Type of feeder—Special arrangements of solution pumps or a special silica feeder which prepares and feeds the solution.

(3) Dilution activates silica is usually prepared in concentrations of 1.5 to 2.0 per cent depending on the activating agent used. The solution is diluted to 0.6 per cent for storage and feeding.

k. Soda Ash—See Softening Sect. 5-b.

3 . . DISINFECTION

a. Chlorine.

(1) Types of feeders.

. . . Direct feed of liquid chlorine—uncommon.

. . . Direct feed of chlorine gas (pressure or dry feed)—uncommon.

. . . Solution types (semi-vacuum and full vacuum) generally used.

(2) Dissolving.

. . . Because of low solubility of chlorine gas in water, special provision must be made for the dispersion of the gas in water under treatment.—A closed system must be under pressure; in an open system there must be 10 or 12 feet of water over the diffuser.

. . . A relatively stable solution of chlorine in water is produced in the solution type feeder by mixing the chlorine with water passing through the ejector.

. . . Approximately 17 gal of water are required to dissolve one pound of chlorine to form a saturated solution. For practical purposes, double this amount is used.—The actual water required for a chlorine feeder depends on the back pressure against which the feeder must discharge and the capacity of the chlorine feeder, itself.

b. Hypochlorites.

(1) Types of feeders.

. . . Positive displacement proportioning pumps are best, operated either by electricity or by water flow through a meter.

. . . Decanting and orifice type solution feeders have been used, and are frequently found in temporary installations.

(2) Feeding concentration.

. . . The best concentration for feeding is 2 per cent solution as a maximum; that 2 per cent being calculated as available chlorine, produced by adding 0.25 lb of high test hypochlorite per gallon of water.

. . . Sodium hypochlorite is usually obtained commercially as a solution containing 15 per cent available chlorine. It is used principally in small installations.

c. Chlorine Dioxide.

(1) Chlorine dioxide is produced as used by the action of chlorine (or hypochlorite and acid) on sodium chlorite in a special generator.

(2) Sodium chlorite solution is fed by proportioning pumps and chlorine by chlorine feeder of solution type. If hypochlorite and acid are used, with sodium chlorite to generate chlorine dioxide, both are fed with proportioning pumps.

(3) Preparation conditions.

. . . The chlorine water must have a chlorine content of at least 500 ppm and a pH of 3.5 or less.

. . . A 2 per cent solution (maximum) of chlorine dioxide is common.

d. Ozone.

(1) Ozone for disinfection is not common in the United States but is used to some extent in Europe.

(2) Type of feeder—A special ozonator, in which dry air is passed through pyrex glass tubes and subjected to a brush discharge of electricity.

(3) Concentration and solution.

. . . Approximately 1 per cent ozone is produced in the air.

. . . The ozonized air is added to the water under treatment by diffusion through porous media, or by passing the water through a scrubber or by spraying the water into the air stream.

e. Other chemicals.

(1) Ammonia, when used for chlorine-ammonia treatment is added by a gas feeder similar to a chlorine feeder but designed for adding ammonia.

(2) Sulfur dioxide, added for dechlorination, can be fed through a feeder similar to a chlorine feeder but designed for that special purpose.

4 . . FLUORIDATION

a. Sodium Fluoride.

(1) Type of feeder.

. . . Volumetric feeders (disc type) with recording devices—up to 10 lb per hr.

. . . Gravimetric loss-in-weight feeders from 1 to 500 lb per hr.

. . . Solution feeders of all types, but proportioning pumps preferred.

. . . Saturators.

. . . Where dry feed machines are used, dust collectors or dust preventing bag-loading hoppers should be used.

(2) Dissolving.

. . . For dry feeders use 1.0 per 12 gal of water and allow 5 minutes detention time in the dissolver.

. . . For solution feed, use 1.0 lb per 3 gal of water (or more) and provide adequate stirring.

. . . Saturators depend on the low solubility of fluoride compounds and the rate of flow of water is adjusted to provide a solution of approximately ¼ maximum solubility.

b. Sodium Silicofluoride.

(1) Types of feeders—Same as for sodium fluoride.

(2) Dissolving.

. . . Sodium silicofluoride is about one-fifth as soluble as sodium fluoride and therefore requires five times as much water for dissolving. Usually, about 1.0 lb per 60 gal of water is used as the ratio; this ratio gives a solution about ¼ of maximum solubility.

. . . Sodium silicofluoride, while

less soluble contains about 60 per cent fluoride ion compared to about 44 per cent for the sodium fluoride.

c. Fluosilicic Acid.

(1) Type of feeder — Proportioning pump only.

(2) Feeding concentration — Feed direct from container at 22 to 30 per cent concentration.

d. Hydrofluoric Acid.

(1) Type of feeder — Special hydraulic displacement system using mineral oil.

(2) Feeding concentration — Feed direct from containers at 60 per cent concentration.

e. Ammonium Silicofluoride.

(1) Types of feeders — Same as for sodium fluoride.

(2) Best feeding strength.

. . . For dry feed machines, use 0.5 lb per gal of water.

. . . For solution feed devices, use up to 1.5 lb per gal of water.

5 . . Softening

a. Lime.

(1) Quicklime — See Coagulation, Sect. A-2-h-(2), (3).

(2) Hydrated Lime — See under Coagulation, Sect. A-2-h-(2), (3).

b. Soda Ash.

(1) Types of feeders.

. . . Gravimetric loss-in-weight for rates up to 500 lb per hr.

. . . Belt gravimetric feeders for rates of 20 lb per hr and up.

. . . Volumetric dry feeders for rates of 1.0 lb per hr and up.

. . . Solution feeders; all types.

(2) Dissolving.

. . . For dry feed machines, use 0.25 lb per gal if the dissolving time is 10 minutes, or use 0.5 lb per gal if the dissolving time is 20 minutes.

. . . For solution feeders use 1.0 lb per gal of water.

c. Carbon Dioxide.

(1) Type of feeder — Generator and meter; under-water burners; gas feeder.

(2) Dissolving — Gas is diffused directly into water; control is by pH observations.

d. Dolomitic Lime.

(1) Type of feeder—Same as for calcium lime—See Sect. A-2-h-(2).

(2) Dissolving—Only the calcium portion of the dolomitic lime is effective for water softening, and dosage is made accordingly; dolomitic lime is useful for silica removal due to its magnesium content.

e. Ion-Exchange.

(1) Ion-exchange materials are not fed to water; water is passed through beds of the material.

(2) Regenerating salt is usually fed as a brine produced by a saturator type feeder.

TABLE 2

Composition of Fluoride Chemicals[1]

Chemical	Formula	Spec. Grav.	Commercial Strength, Per Cent	Fluoride by weight Per Cent	Quantity Required to give 1.0 lb of Fluoride Pounds	Gallons
Ammonium silico fluoride	$(NH_4)_2SIF_6$		98	62.8	1.59	
Fluosilicic acid	H_2SiF_6	1.2742	30	23.73	4.21	0.396
Same	H_2SiF_6	1.2235	25*	19.78*	5.05	0.495
Same	H_2SiF_6	1.1941	22	17.4	5.72	0.574
Hydrofluoric acid	HF	1.24	60	57.0	1.75	0.17
Sodium fluoride	NaF		98	44	2.27	
Sodium silico fluoride	Na_2SiF_6		98.5	60	1.67	

* Actual analysis for some 25 per cent solutions shows a content of H_2SiF_6 of 21.4 per cent and a fluoride content by weight of 17.1 per cent.

[1] From Tech. Memo—10-M6 of B-I-F Industries, Inc., by permission.

6 . . Taste and Odor Control

a. Activated Carbon.

(1) Types of feeders.

. . . Gravimetric loss-in-weight feeders for rates up to 300 lb per hr.

. . . Volumetric feeders for rates of 1 to 300 lb per hr depending on design of feeder.

. . . For dry feeders use dust collectors or dust preventing bag-loading hoppers.

. . . Slurry feeder, rotating dipper type.

(2) Slurry concentration.

. . . Common practice is to use 1.0 lb of carbon to 1.0 gal of water. Wetters with eductors require 10 gpm for rates up to 10 lb per hr, 20 gal per min for rates up to 30 lb per hr, and 150 gpm for rates of 300 lb per hr. Slurry storage requires some form of agitation to maintain the carbon in suspension during feeding; propeller agitators are used.

b. Chlorine—See data under "Disinfection," above; Sect. A-3-a, b.

c. Chlorine Dioxide—See data under "Disinfection," above; Sect. A-3-c.

d. Copper Sulfate—Usually fed to reservoirs from boats; spread by broadcasting crystals or sprayed as solution; concentrations calculated according to area and depth to be treated.

7 . . Miscellaneous Treatment

a. Other, less common treatment operations include silica removal, fluoride removal, dechlorination, etc.

b. Chemicals used depend on the particular operation desired and types of feeders depend on chemical used.

B . . . Operation

1 . . Control

a. Chemical analysis are usually the basis of ultimate control of chemical dosage and feed rate.

b. Actual control to give the required dosage and feed rate can be by any of the common control systems; i.e., manual, semi-automatic, step, programmed, or flow-proportional. Fully automatic control by feed-back is feasible only in certain instances with special equipment.

c. Operating Control Nomogram.

(1) Figure 2 is a control nomogram which gives the relation between flow, dosage, and feed rate.

(2) This nomogram is applicable to flows and dosages of any amounts by proper manipulation and the use of factors of 10 or multiples thereof.

(3) If some part only, of the chemical fed is the reacting portion and the feed rate or dosage of that ion alone is desired, a proper percentage factor must be used with the data obtained from this nomogram.

. . . For example if fluoride compounds are used the percentage factors must take into account the purity of the compound as well as its chemical composition. Table 2 shows data on the fluoride compounds.

2 . . Problems

a. Operating difficulties arise for a variety of reasons.

(1) Arching of chemicals in dry feed hoppers.

(2) Caking of chemicals due to moisture.

(3) Poor grade chemicals.

(4) Impurities, particularly insolubles in chemicals.

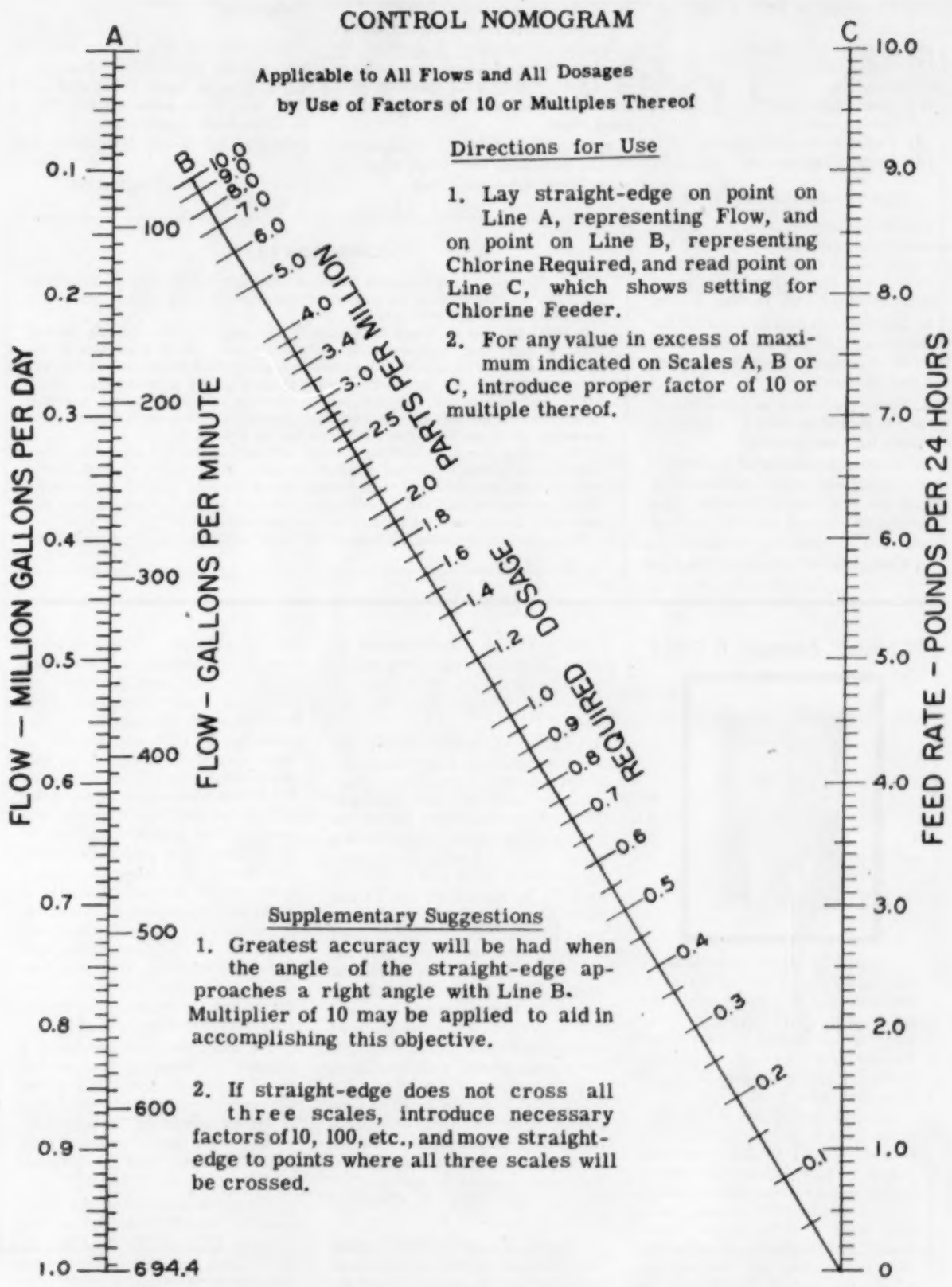


Fig. 2—Chemical feed control nomogram (Adopted from Keep-Sheet No. 21 of B-I-F Industries, Inc.)

(5) Variation in bulk density of chemicals.
(6) Mechanical failures.
(7) Other factors.
b. Remedies.
(1) Alert operators.
(2) Good records.
(3) Preventive maintenance.
(4) Factory service.

3 . . PREVENTIVE MAINTENANCE

a. The first step in preventive maintenance is to know the equipment; for this purpose an operator or mechanic should study the instruction manual which comes with the feeding device.

b. Special tools may be required for maintenance; if so, they should be kept in a particular location set aside for that purpose.

c. Spare parts may be required and these too should be kept in a location set aside for that purpose.

d. A definite schedule of preventive maintenance and inspection should be set up for each chemical feeder, that schedule to depend on the type of feeder and its operating schedule.

e. Complete records should be kept of all inspections and operations.

f. Preventive maintenance includes operation of standby equipment, inspection, cleaning, lubrication, replacement of worn parts, painting, and when necessary complete overhaul of equipment.

g. Chemical feeding equipment should be treated with respect—never abused, and *never* neglected.

References

Material for this lecture was obtained from the AWWA Manual of Water Quality and Treatment (2nd Ed.) and from various Keep Sheets on Chemicals (particularly No. 22), published by B-I-F Industries, Inc.

NEXT LECTURE—Coagulation

CORRECTION ! ! !

E. A. Sigworth, of the Industrial Chemical Sales Division of West Virginia Pulp and Paper Co., has called to the author's attention an error in Part 2 of this lecture on Chemical Handling and Feeding.

In the July issue of Water & Sewage Works, page 296, 2nd column, Section F-4-a, it states that "activated carbon is a fire hazard and in dust form in the atmosphere may be explosive." This statement is incorrect; it should read as follows:

Activated carbon will burn with a steady glow, if ignited at temperatures above 400°C. Inasmuch as the activation process removes all volatile matter, activated carbon dust in the air will not explode. Although activated carbon burns with practically no flame, paper bag containers may be a flame hazard.

The greatest danger in handling burning activated carbon will arise from using standard fire fighting equipment. A stream of water, such as from a fire hose, should never be used, because it will cause burning carbon particles to fly in all directions. Thus fire would spread, and firemen would be liable to severe burns. A very fine mist spray is recommended for fighting activated carbon fires.

Dust control is desirable, not so much for safety's sake as for general cleanliness.

"Charlie" Emerson Is Dead

"Charlie" Emerson passed away on August 24th after an illness of five weeks. He was 73 years old and lived in East Orange, N. J. He was a senior partner in the firm of Havens and Emerson, consulting engineers, with offices in Cleveland, Ohio, and New York City.

Christened Charles Alvin Emerson, he was born in Beloit, Wisconsin, July 10, 1882. He attended Beloit College, where his grandfather was Professor of Greek for forty years. In 1903 he was graduated with a B.S. degree "cum laude" and thereafter attended the Mass. Institute of Technology, where he won a B.S. degree in Sanitary Engineering in 1905. Later, he took a graduate course in Public Health Administration at Johns Hopkins University, while serving with the Pa. State Dept. of Health as principal assistant engineer.

"Charlie" Emerson began his career as assistant engineer on the design of the Columbus, Ohio, softening and filtration plant in 1905. He then (1906) joined the Baltimore Sewerage Commission where America's then largest sewage treatment plant was to be built. In 1911 he moved to the Penna. State Dept. of Health and three years later (1913) became its chief engineer, which position he held for nine years. In 1923 he joined the firm of Fuller & McClintock, internationally known consulting sanitary engineers. After the death of George W. Fuller, Emerson in 1936 became associated with the Cleveland firm, George Gascoigne and Associates. After the death of Gascoigne, Emerson in 1940 entered into partnership with Mr. Havens to form the firm of Havens and Emerson, consulting sanitary engineers, with offices in Cleveland and New York.

During his professional career Mr. Emerson served on numerous technical committees, authored many papers and was the recipient of many honors. An honorary degree of C.E. was bestowed upon him by Pennsylvania College in 1917. He took over the work of George W. Fuller in organizing the Federation of Sewage Works Associations in 1928 and for eleven years served as chairman of this association's Board of Control. When the Federation began holding annual meetings Emerson was made its first president and one of the Federation's principal awards was named The Emerson Award in his honor. He had continued to serve the Federation in numerous capacities, the chief of which was chairman of the Constitution and Bylaws Committee. In recognition of "Charlie" Emerson's service to the Federation he was made its first Honorary Member.

Mr. Emerson was a member of a number of technical and professional associations and had served as contributor to such texts and reference works as "Sewage Disposal," "Solving Sewage Treatment Problems" and the "Manual of Water Works Practice."

He was a member of the Engineers' Club of Philadelphia, Machinery Club of N. Y. City, the MIT Club and Sigma Chi college fraternity. His final resting place is Beloit, Wis., where the Emersons have lived for generations.

A DRINK FOR CONNIE

My Grandchild climbs upon the chair
Left standing by the sink
To turn the kitchen faucet on
And get herself a drink.

A simple thing she does perhaps
A dozen times a day,
So simple that it scarcely takes
A moment from her play.

So simple that I'd near forgot
A fact I now recall,
That in my youth a thing like this
Just wasn't done at all.

The water was inhabited
By horrid bugs and germs,
By things whose names I can't pronounce
And little wiggly worms.

There microscopic murderers
And thugs just loved to roam.
The kitchen tap became the source
Of poison in the home.

Those days are gone. Now there are men
Whose work makes doubly sure
The water that's delivered to
Our homes is always pure.

We take all this for granted and
We give but little thought
To those whose work and vision has
This great improvement wrought.

But I for one am grateful that
There's now no cause for care
Whene're my Grandchild wants a drink
And climbs upon her chair.

Verses by Homer Beckwith
Drawing by Emma Beckwith

Ed. Note:—We are privileged to publish the above illustrated verse contributed by Mr. and Mrs. Homer E. Beckwith.
Mr. Beckwith composed this tribute to those responsible for advances in water purification practices, and cleaner water supplies through stream pollution abatement. He is District Manager for Pitometer Associates, Inc.
To Mrs. Beckwith goes the credit for the hand lettering of the tribute and the sketches of her little granddaughter "Connie".

The Membrane Filter Applied to Water Supply Control

Development of this extraordinary laboratory device provides a means for rapid detection of bacterial contamination

by JOHN H. BUSH
Millipore Filter Corp., Watertown, Mass.

AFTER World War II a team of scientists from the Army Chemical Corps became aware of the development in Germany of an extraordinary laboratory device. This was the membrane filter (MF), which had its origin in that country. The Chemical Corps, therefore, initiated research on the device and projected modifications and refinements in the membranes to provide more rapid detection methods for bacteria and other possible agents of biological warfare.

The best defense against a biological attack is quick and reliable detection procedures so that administration of serums and antibiotics may begin at once. Standard procedures were hopelessly inadequate, in that they required four days in some cases and many victims would certainly be beyond help in this period.

The research was initiated and directed by the Chemical Corps at the California Institute of Technology and subsequently with the Millipore Filter Corporation (then a division of the Lovell Chemical Company) on the basic mechanisms involved in producing the membranes, and then on volume production methods.

This research has resulted in the development of a material that appears like paper in that it is a white sheet material. It represents, however, an orientation of cellulose-esters in cell or pore walls approaching molecular dimensions. It provides a "screening" device for concentrating particles in the microscopic range in size on a plane surface.

The pores of the MF function as though they were closely packed parallel cylinders of a size of 1/50,000 of an inch in diameter and varying in size by less than 1/500,000 of an inch. These filters may be made to have uniform pores of various diameters by extremely delicate controls in production methods. Thus, separatory screens are available to the laboratory to effectively separate on a plane surface particles which can only be detected with the electron microscope.

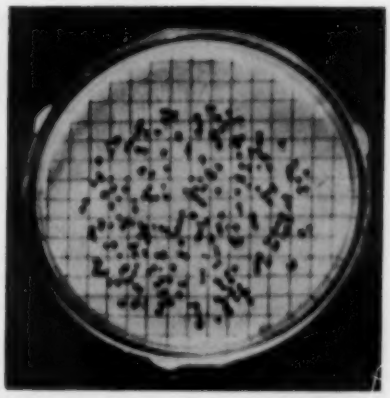
Largely through the insight of some of the leading officials in the field of public health, the MF Millipore Filter was released from military security to permit application to problems of public health. A program was initiated to study the feasibility of applying this filter to the bacteriological analysis of water, with the cooperation of the U. S. Public Health Service, The American Water Works Association and the American Public Health Association, together with other interested agencies. This work has been in progress for approximately four years and has resulted in the definition of methods of analysis which are clearly of profound significance in public health control measures.

Use of the filter is one of the simplest possible laboratory techniques: bacteria are concentrated on the surface of the MF when contaminated liquids are passed through the filter. These organisms may be cultured or grown on the surface of the filter when nutrients are provided. Thus the bacteriologist, for the first time, may concentrate organisms from a large volume of liquid and culture them on the filter surface into colonies in order to identify the specific types.

Organisms that are concentrated and cultured in this manner may be counted with the naked eye in as little as 8 hours and positively identified within 16 hours. This is contrasted with other bacteriological culturing procedures, essentially as old as the science of bacteriology, which give comparable results only after four or five days.

The new MF procedures are much more sensitive, accurate, and reliable than former techniques. In providing earlier detection methods, the Army Chemical Corps has developed a new

BACTERIOLOGICAL analyses are conducted routinely with the membrane filter by the Flint, Mich., Department of Public Health



FILTER HOLDER is connected to portable centrifugal pump for bacteriological analyses of potable waters and sewage. Filters and unbreakable plastic Petri dishes complete the required accessories. Bacteria may be captured, cultured and easily counted (right) on the filter surface in a few hours. Differential media are available

defense weapon which may be of incalculable importance.

It is worthy of note here that in the light of highly exciting possibilities suggested by applying the MF to the bacteriological monitoring of water supplies, the problem of adapting methods was critically approached with objectivity and a highly proper conservatism.

The MF procedures represent a radical change of methods from those that have been employed over a period of many years. It is significant that highly exacting criteria were used in evaluating results, and that the methods were placed under test with a number of laboratories to establish reproducibility of results under conditions varying with seasonal and geographical factors.

Clearly the official tentative status of the MF method of water analysis which has been announced recently is in anticipation of its standardization. Before the MF method becomes the basis for establishing potable water quality and any complete abandonment of older methods occurs, it is clearly desirable to confirm the validity of results in the hands of a large number of laboratories to be certain that no extraordinary circumstances or water conditions are overlooked in evaluating the method, and also to establish that the method is workable and gives reproducible results in the hands of technicians in these laboratories. On the latter score the simplicity of the MF method as compared with the MPN (Most Probable Number) method which is now standard, leaves little question.

In the light of the foregoing it would seem that there should be no delay in establishing the MF in the water laboratories. From the standpoint of national defense, it is maintained that a rapid and effective method of monitoring abnormal populations of microorganisms should be established over the country as a whole.

Water is one of the most efficient media for spreading disease. Methods should yield results in a short enough period to permit warnings and/or corrective measures before people become widely infected. The MF would seem to offer the greatest promise for isolating specific pathogens which might be in low concentrations and still be lethal.

More sensitive and controllable conditions of culturing organisms on the MF surface should permit the development of highly selective media. That the responsibility and, in fact, the only hope for the safety of the general public rests with the local laboratories can hardly be questioned in the light of the destruction and failure of communication facilities resulting from saturation bombings experienced in World War II and the incomprehensible devastation possible with A-bomb or H-bomb attacks.

Dozens of State Health Departments and the U. S. Public Health Service have conducted training schools for supervisory personnel and technicians in the water supply field.

In many communities the MF has now been adopted as a routine technique for the examination of source and finished waters, for placing pipelines in service after construction or repair, and for control of stream pollution. In every case the legal minimum of the old MPN tests is still performed. This serves the added useful purpose of affording still more data to correlate the new with the old, while at the same time making full use of the advantages in the new MF techniques. The savings in valuable laboratory personnel time have often permitted much more extensive controls than would otherwise prove practical.

At present, a large number of laboratories investigating widely diverse fields of inquiry are working with the MF to define techniques of application in other fields. It is not possible to predict the ultimate significance of this new tool, but it is now being used in virus research and a wide range of clinical-medical applications. It provides more sensitive and simple methods of monitoring radioactive airborne hazards. In many fields of routine analysis the MF has provided simplified, more accurate and reliable testing methods at a reduced cost.

Rolling Pipe Crushes Two Workers On Colorado Springs Water Line

Two 120-foot sections of pipe, each weighing five tons, recently rolled into a deep trench and crushed to death two laborers working on a pipeline for Colorado Springs, Colo. Five other workmen, warned by shouts, clambered to safety.

According to a spokesman for the R. H. Fulton Co. of Lubbock, Tex., contractor on the job, the men were trimming the deep trench preparatory to laying the 30-inch pipe, which was placed alongside. High winds were thought to have caused the pipe to roll from wooden skids on which it was resting.

Besides providing additional water for Colorado Springs, the pipeline also will provide the 5 mgd the city has contracted to supply the new Air Force Academy located nearby.

COMPACT arrangement of plant units consolidates pre-aeration (left), final settling (right) and aeration (background)

Seymour Solves Unusually Difficult Waste Treatment Problem

by M. O. Clinton

Mr. Clinton is President of McMahon Engineering Co., Menasha, Wisconsin. **His article is a case history account of the planning, construction and operation of improvements to a sewage treatment plant grossly overloaded by milk processing and cannery wastes.**

SEYMOUR, Wisconsin, located in the northeastern section of Outagamie County in the heart of a very rich agricultural and dairying region, felt the full impact of the expansion of the milk products and food processing industries during and after World War II.

The increase in industrial waste, due to the expansions of these industries, caused such an overload on the existing sewage treatment plant, that the effectiveness of the plant was reduced to nil. In the spring of 1952, the city set out to correct this problem.

History

The municipal sewer system and the sewage treatment plant were built in 1935-36 at a cost of $22,276. They had been designed for a population of 2,000 plus an additional 500 population equivalent to handle waste from a maximum of 13,000 pounds per day of milk intake from a receiving station and the effluent from a small canning factory which first treated its waste by screening and chemical treatment in draw-and-fill tanks.

The plant was a straight activated sludge plant and consisted of a manually raked bar screen, a raw sewage well and pumps, one primary tank, three aeration tanks with downdraft mechanical aeration, one final tank, a digester, sludge beds, and a service building. It worked exceedingly well for the first few years of operation, producing a crystal clear effluent with a B.O.D. reduction of from 90 to 95 percent.

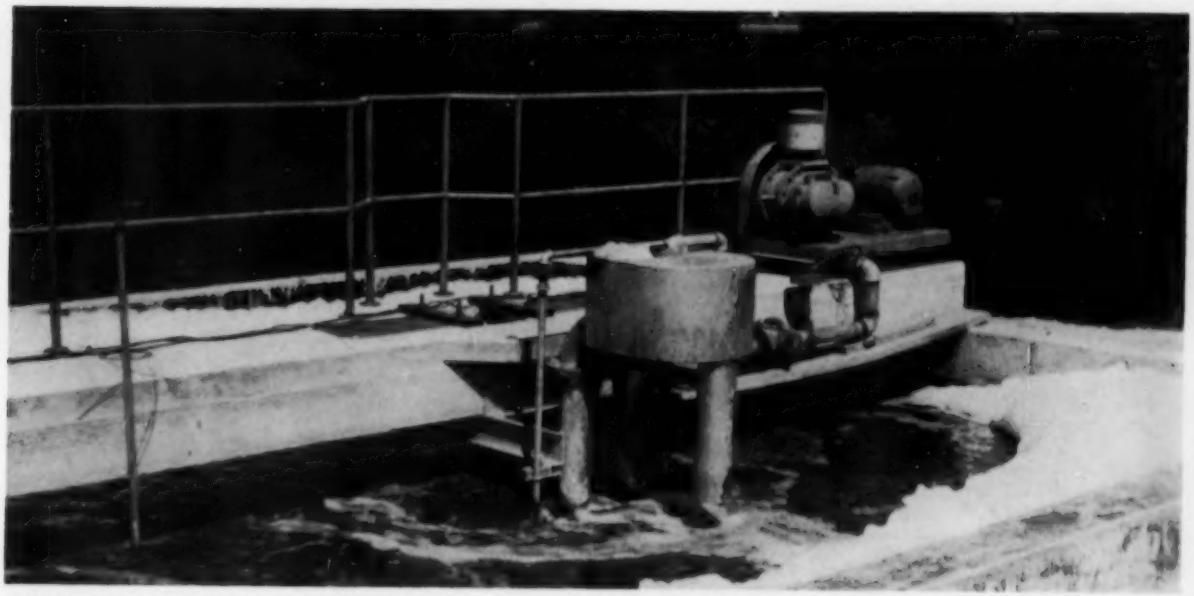
During World War II, however, the Badger Consolidated Cooperative mushroomed from a small receiving station to a very large sized milk processing and pasteurizing plant. Also, the Seymour Canning Company increased its packing operations to the extent that their fill-and-draw tanks gave little, if any, treatment to the waste and were finally abandoned entirely, with the untreated waste being discharged into the city sewers.

As a result of this large increase of industrial waste, the treatment plant could not carry the load imposed upon it. At no time was there any semblance of activated sludge and during most of the year odors from the plant and nearby stream could be characterized as a gross nuisance. Dissolved oxygen was entirely depleted from the nearby stream.

Studies

The loadings and the source of waste were carefully investigated. It was found that the Badger Cooperative was processing an average of more than 250,000 pounds of milk per day, with a peak of over 340,000 pounds. Some 40,000 to 50,000 pounds per day were used for making cheese. The Badger Cooperative processed approximately 83,000,000 pounds of milk in 1954.

The Seymour Canning Company canned peas, whole corn, beets, green



CIRCULATING airlift and impingement aeration units are served by blower with unusual outdoor mounting

and string beans, carrots, pork and beans, and sauerkraut. Their canning operation, which extends from the middle of June to the latter part of December, or about a six-month period, has reached a maximum of about 4,000 cases per day. The 1954 pack totaled 324,752 cases.

The State Sanitary Department recommended that the Badger Cooperative build a trickling filter and holding tank, and that the Seymour Canning Company pond its waste. However, investigation showed that it was not feasible from the standpoint of location in convenience and expense for either to provide for its own waste treatment plant. Therefore, they asked the city to provide for the treatment of their wastes in the municipal plant.

Use of trickling filters for secondary treatment in place of the existing activated sludge units also was considered. However, on the basis of the known loadings, it was found that it would require four trickling filters approximately 90 feet in diameter to give the BOD reduction required and to provide a sufficiently stable effluent to be acceptable for discharge into the small sluggish receiving stream. The trickling filter method was obviously prohibitive from the cost angle, from the standpoint of both the city and industries.

The suggestion was made that alum or some other suitable coagulant be added to the return activated sludge as a means of increasing the capacity of the present activated sludge plant. A temporary dry feed machine was rigged and a coagulant was added to the return activated sludge.

The results of the use of this coagulant were promising. The most immediate result was the complete elimination of odors from the plant. An activated sludge never actually formed, but a good floc was noted and a considerable amount of solids, which formerly had gone over the final tank weir, were being settled out. However, it was apparent that neither the primary nor the final tanks were adequate. Furthermore, the mechanical aerators were not capable of injecting enough air to produce a dissolved oxygen residual anywhere in the plant.

TABLE 1
Treatment Plant Unit Data

Unit	No.	Size	Detention Time Min.	Detention Time Ave.
Pre-aeration[1]	1	20′ x 20′ x 10′ WD	60 min.	120 min.
Primary	1	18′ x 10′ x 8′ WD	65 min.	130 min.
	1	33′ x 11′ x 9′ WD		
Aeration[2]	4	21′ x 21′ x 14.5′ WD	.....	7-8 hr.
Final	2	38′ x 9′ x 9′ WD	92 min.	184 min.
Digester	1	1000 cu ft	.....	.....

[1] Walker downflow mechanical aerator, 7½ hp
[2] 4 Walker impingement aerator units; 1 blower, 10 hp, 210 cfm at 6 psi; 2 blowers, 7½ hp, 160 cfm at 6 psi

Plant Design and Improvements

As a result of the foregoing studies and experiments the plant was expanded to take care of the industrial load by the following steps:

1. Addition of a pre-aeration unit with downdraft mechanical aerator.
2. Addition of a comminutor in place of a manually raked bar screen.
3. Conversion of the existing final tank to another primary tank.
4. Addition of one aeration tank to make four in all.
5. Replacement of the downdraft mechanical aerator in tanks No. 1 and 3 with Walker impingement-type diffused aeration units.
6. Addition of two final tanks.

IMPINGEMENT *aeration units on centerline give excellent agitation to tank contents*

7. Enlargement of the existing service building.

The number and sizes of plant units are given in Table 1.

Additions to the Plant

Additions to the plant were built by a general contractor, but the new aeration equipment was installed by a city crew. Because all headers, piping, air lift, etc., were furnished by the equipment manufacturer and shop fabricated, installation was simple. The motors and compressors were mounted on the old bridges originally required for the mechanical aerators. This permitted the use of existing electric conduit.

The improvements were completed and the plant placed in full operation in June 1953 only two days before the canning season started. The plant should have been put in operation at least a week before the canning season to give it a chance to operate as an activated sludge plant before the heavy industrial load was imposed on it.

Operating Results, 1953 and 1954

The 1953 season was one of the best in the history of the canning plant. Canning operations were carried on during an average of 18 hours per day, with waste loadings of 20,000 to 25,000 population equivalent.

Under these rigorous conditions the treatment plant operated satisfactorily, showing BOD reductions of pea and corn waste of from 95 to 98 percent. Even with the beet waste, which carried a larger BOD load, the plant showed a BOD reduction of 90 to 92 percent. This was not sufficient to cause depletion of the dissolved oxygen in the small receiving stream.

After further studies were made during the 1953 season, it was decided to replace the downdraft mechanical aerators in tanks No. 2 and No. 4 with Walker impingement-type diffused aerators. Also, one 10-hp motor and compressor was added to increase the air capacity for handling the beet waste. A coagulant was added during the pea, corn and beet canning season only.

The results obtained during the 1954 operating season were indeed most gratifying. Table 2 gives a summary of the plant performance during 1954. These are average results, in which the operating results for each particular vegetable pack are grouped together and averaged. There were some "peak" days which were considerably above this average, reflecting the ups and downs of canning plant operation. At all times, a water clear effluent was produced. Even during the beet pack we were surprised and gratified to see that the characteristic blood-red color of the beet waste was almost completely removed. The only color remaining in the effluent during the beet pack was a light straw color.

The coagulant, used only during the pea canning, whole grain corn canning and red beet canning seasons, was

TABLE 2

Summary of Plant Performance, 1954

Loading Status	Ave. Daily Flow, gal.	BOD Raw, ppm	BOD Prim. Effl., ppm	BOD Rem., %	BOD Final Effl., ppm	BOD Rem., %	Final Effl. D.O., ppm	Coagulant Used, lb/day
Before canning season[1]	150,000	625	188	70	15	97.6	2.0	0
Pea canning	300,000	752	303	60	20	97.3	2.5	800
Corn canning[2]	300,000	723	236	67.5	7	99	2.1	800
Green bean canning	300,000	340	175	48.5	13	90.3	3.2	0
Red beet canning[3]	250,000	695	220	68.3	20	97	2.1	625
Carrot canning	175,000	705	355	49.3	18	96.1	3.5	0

[1] Peak milk waste load [2] Whole grain [3] Includes some sauerkraut

TABLE 3
1954 Canning Pack

Type	No. Cases[1]	
Peas	94,708	
Corn	36,355	
Beets	27,060	
Sub-total		158,123
Carrots	12,143	
Pork and beans	39,048	
Sauerkraut	51,684	
Beans, green and string	63,754	
Sub-total		166,629
Total		324,752

[1] Case = 24 1-lb cans

added both to the raw sewage and to the return activated sludge. Waste activated sludge was discharged to the raw sewage so that it would receive the additional benefit of the coagulant and aeration in the pre-aeration unit.

It is possible that good operation can be obtained with less chemical coagulant. However, this cost is nominal, and will be determined in subsequent canning seasons when more time is available for the operator to experiment.

Chemical was not added immediately at the start of each of these packs. Instead, plant operation was closely observed as soon as canning started, taking note of the dissolved oxygen in the aeration tanks and the condition of the sludge in the final settling tanks. As the dissolved oxygen approached zero and the sludge in the final tank showed signs of incipient bulking, the coagulant was added.

It was amazing to note how fast the plant "came around" after chemical was added. It took only a matter of a half day before the dissolved oxygen would come back up and the sludge would settle down to a cohesive blanket 4 or 5 feet below the weir troughs.

The Walker impingement aeration units did a good job of air diffusion. Each header was located along the centerline of the tank, which caused the contents to be stirred in two back-to-back spiral rolls. This gave excellent stirring and good air diffusion. At no time did the dissolved oxygen in the aeration tanks get below 2 ppm. No maintenance or repairs were required on these units throughout the entire season, even though there were several power failures which allowed the diffusers and air supply riser pipes to backfill with tank liquor.

Because this was the first operating season it was not known just what suspended solids concentration should be maintained in the mixed liquor. It was necessary, therefore, to operate on somewhat of a "cut and try" system. An attempt was made to hold the solids down as much as possible, but any time clarification suffered or a tendency to bulk occurred, the solids were allowed to increase.

In reviewing the operating data, it was found that somewhere between 3.7 and 4.5 pounds of mixed liquor solids were being used per pound of 24-hour BOD applied. This did not vary with the use of the coagulant in the return activated sludge.

Disposal of sludge is still an undecided problem. The digester is obviously undersized. During the heavily loaded part of the season the digester was used merely for sludge storage, with sludge being hauled away periodically in a tank truck and disposed of by spreading on agricultural land.

This may be the permanent method of sludge disposal, because farmers in the vicinity have welcomed the sludge for fertilizer and the cost of tank trucking has not been particularly high. Investigating is under way to assess the possibility of dewatering the sludge, rather than hauling it in the tank trucks, and disposing of it in an incinerator together with municipal garbage and refuse. This, however, is not a pressing problem and no immediate change in plans is contemplated.

Operating and Plant Costs

The original plant cost about $22,300, which with the additions of approximately $50,000 brings the total plant cost to about $72,300.

Connected horsepower, including pumps, blowers and sludge collectors, totals 45. Of this, the blowers represent 27½ hp and the pre-aeration unit 7½ hp.

During the canning season, all of the blowers are operated and the mechanical aerator on the pre-aeration unit is run continually. When the cannery is not in operation, from the end of the canning season to about the middle of June, only one 10 hp blower is needed and the pre-aeration unit is operated about 40 percent of the time by a time switch control.

During the 1954 season the canning company processed 324,752 cases, as shown in Table 3. For this period the cost of coagulant amounted to $1204.

During 1954 power cost amounted to $4036.50. As shown by Table 4, power requirements indicate the canning season as starting about the middle of June and continuing to the latter part of December.

TABLE 4
1954 Power Costs[1]

Month	Kw-Hr	Cost
January	11,960	$ 239.20
February	10,714	214.24
March	11,168	223.36
April	9,826	196.52
May	12,957	259.14
June	16,006	320.12
July	20,188	403.46
August	25,132	502.64
September	20,559	411.18
October	26,553	531.06
November	26,286	525.72
December	23,078	479.56
Total	215,327	$4,036.50

[1] Average = $0.019 per kw-hr

The plant is operated by one full-time operator with assistance from the city labor pool as required.

It has been particularly gratifying to the city officials to have the farmers call and tell them how pleased they are that the pollution of their stream has been stopped.

The pre-aeration unit is found to be an economical and valuable addition to an overloaded plant. It greatly increases BOD removal in the primary and serves as an excellent flocculation unit when chemical treatment is used.

Acknowledgments

The author wishes to express his appreciation to the following City of Seymour officials who by their cooperation and help made it possible to design and improve the present plant to handle the heavy industrial waste entering it:

Walter Muehl, formerly Director of Public Works, and Wayne Jensen, his successor; Levi Blohm, Plant Operator; Maynard Puls, formerly City Clerk, and Mrs. Mary Puls, his successor.

Other city officials who made construction and operation of the present sewage treatment plant possible are Mayor Carl Kuehne and Aldermen Elmer Krah, Thomas Lanwehr, Earl Fenn, Herbert Hartwig, Maynard Mott and Elmer Seidl.

W&SW

Interference by Industrial Wastes in the Mohr Test for Chlorides

The discovery that organic sulfur interference can serve a useful purpose and that corrective measures improve accuracy of the test

by MICHAEL J. TARAS

Mr. Taras is Research Sanitary Chemist, Department of Water Supply, Detroit, Mich. In this paper he reviews the suitability of the Mohr method for chlorides as a field test, reports on experience with interference caused by industrial wastes, and presents corrective measures which are applicable.

THE PERIODIC appearance of tastes of a phenolic nature, following the marginal chlorination of the Detroit raw water supply, prompted an investigation of the prevailing pollution picture. A cabin cruiser, staffed with a boat operator, was placed at the disposal of two chemists assigned to chart the dispersion of taste-producing bodies in nearby Lake St. Clair and in the more distant St. Clair River.

The International Joint Commission had declared in a formal report[1] that the phenol discharges from an industry in this geographical area should not exceed an average of 2 ppb. and a maximum of 5 ppb. following initial dilution in the receiving waters. An immediate objective of the survey trips was to determine if this standard was observed.

In this study, it was necessary to make a choice between the character of the work that could be performed on board ship and that best reserved for the plant laboratory. Because of the restricted amount of space aboard the boat, it was essential to select chemical determinations offering the greatest potentialities in the field.

Conducting analyses in the field offers a number of undeniable advantages: (a) the findings can be translated into immediate action, with a notable reduction of wasted motion; (b) a revision of the sampling program can be undertaken as the circumstances warrant; and (c) the field analysis presents the actual situation, before changes attendant upon standing can occur in the sample.

Chloride Titration in the Field

An analysis which can be performed in the field and aboard a boat, is the Mohr titration for chloride. Although not the simplest of determinations, few demands are imposed upon the chemist from the equipment standpoint. Two reagents, silver nitrate and potassium chromate, together with two porcelain casseroles and a titration kit comprise the total equipment requirement. The dispensing of the silver nitrate standard solution is easily accomplished nowadays by means of a polyethylene "squeeze" bottle fitted with an automatic student type burette (available commercially from Scientific Glass Co. of Bloomfield, N. J.).

The ninth edition of *Standard Methods for the Examination of Water and Sewage*[2] cautions against interference in the Mohr titration contributed by cyanide, sulfite, phosphate, and sulfide. The interference of the first two anions is positive, resulting in an increase of apparent chloride. Of the phosphate family, dihydrogen phosphate compounds yield an off-color orange with the chromate indicator before the titration is started. Sulfide strikingly interferes with the titration through the instant formation of black silver sulfide, thereby obscuring the normal silver chromate endpoint.

Studies Aboard the Boat

The first boat trip revealed that a considerable concentration of phenol-type compounds was emerging from a small tributary stream, some 50 miles from Detroit's water intake, into which the wastes of an oil refinery were being discharged. The wastes entered from a slow-moving stream into a relatively high-velocity river, flowing about 2 to 5 miles per hour. Once in the river, the wastes were found to hug the near shoreline for 31 miles on the passage downstream. Conditions favoring agitation, such as winds and boat movements in restricted channels, diverted some of the wastes to the opposite shore of the river.

TABLE 1

Relationship in Samples Collected Where Oil Refinery Wastes Predominated

Date	Time	Chloride Concentration		Phenol mg./l.
		Field mg./l.	Laboratory mg./l.	
4-23-54	12:35 P.M.	400*	430	250
	3:25 P.M.	400*	410	280
4-28-54	1:54 P.M.	200*	210	375
5- 6-54	2:39 P.M.	0	560	1300
	5:56 P.M.	0	620	1160
6-29-54	9:25 A.M.	48	820	630
	1:30 P.M.	48	510	590
	3:50 P.M.	10	820	940
	6:05 P.M.	10	770	900
	8:10 P.M.	0	800	1050

* These chloride values indicate no interference. The remaining chloride values obtained in the field are excessively low, due to the presence of interfering substances accompanying high phenol concentrations. The chloride values listed under Laboratory are the true readings obtained after dissipation of the interference.

TABLE 2

Required Ultraviolet Exposure Inorganic Sulfide Intereference Removal 50 ml. Sample

Sulfide Concentration mg./l.	Length of Ultraviolet Exposure Minutes
2	5
4	10
6	20
10	35
20	75

Tests on samples collected a short distance below the outlet of this tributary stream indicated the presence of reduced and occasionally of no chloride, when the titrations were performed immediately on board ship. The appearance of a pronounced darkening in the original yellow color of the sample occurred upon the addition of about 0.2 ml. standard silver nitrate solution, the blank used in the titration. Since the norm for the receiving river along that particular shore was in the neighborhood of 10 mg./l. of chlorides, the result was suspect.

The logic of the situation dictated that the decrease should not be quite so abrupt. Samples brought back to the laboratory for further study justified the initial suspicion. When titrated a day or two later, the chloride content was the highest of any obtained on the survey, reflected the high chloride levels present in the tributary stream.

Interference Caused by Wastes

The distinguishing characteristic of the samples collected at this point in the river was an overpowering petroleum odor. The phenol strength of the discharges varied from day to day, and even on an hourly basis. The variation could not always be noted in the appearance of the river and tributary surfaces. However, the variation was instantly recognizable from the interference experienced in the Mohr titration. Since pure phenol solutions do not react with dilute silver nitrate to yield the low chloride titrations experienced in the field, it was quickly realized that accompanying waste materials were causing the interference.

Sulfide was present in all the samples revealing interference. On the other hand, sulfide could also be detected in samples not showing interference with the chloride test. Doubtless, the interference in many of the samples could be directly ascribed to the presence of excessive amounts of sulfide, 2 mg./l. or more. The comparatively low sulfide levels in other samples aroused the suspicion that sulfide was not the sole cause of the interference.

Another manifestation of the interference in the field was the brownish color of the floc resulting from the addition of 1 g. of copper sulfate pentahydrate to 1 liter of the sample (this reagent was applied for the purpose of preserving the phenol until the distillation procedures could be undertaken in the plant laboratory). Inorganic sulfides convert copper sulfate to a dark-colored product.

The principal concern of these trips was the accumulation of data on taste-producing bodies, of which phenol represented the best known. It was pertinent that a gross correlation, recorded in Table 1, had been discovered between these several interferences and the occurrences of high phenol concentrations at this special sampling site.

Additional Mohr Test Interferences

The following spring and summer, during a re-check of the St. Clair River for taste-producing bodies, another instance of interference in the Mohr titration was discovered. The manufacture of basic chemicals and synthetic rubber, in addition to the refining of oil, is carried out in the area wherein the interference was detected. This second interference was associated with phenol concentrations in the range of 100 μg./l. Although sulfide was demonstrated in the freshly collected sample, the concentration approximated 0.5 mg./l., which normally is below the interfering level.

From such behavior it was postulated that sulfide was not the exclusive interfering agent, but might be a contributory interference, by reason of being associated with other compounds. However, even the related nature of the sulfide interference was not completely justified: the cold sample, after standing two days in a refrigerator, would result in the reduction of the sulfide concentration to less than 0.1 mg./l., without elimination of the interference. After storage, the extent of the interference remained the same as in the original sample.

The specific electrical conductance of the samples showing interference was not exceptionally high, nor was the pH abnormal, indicating that the interference was probably of organic rather than inorganic origin. The presence of sulfide and a slightly increased sulfate content supported the conjecture that organic sulfur compounds might be a fruitful starting point for further inquiry. It was found that the interference could be removed by irradiating the sample with ultraviolet light.

Sulfur Composition of Petroleum

During recent years, oil refineries

TABLE 3

Concentrations of Sulfur Compounds Interfering in Mohr Titration

Compound	Formula	Interfering Concentration in Terms of Sulfur Content mg./l.
Sulfhydryl Compounds		
Ethanethiol	C_2H_5SH	10*
1 - Propanethiol	$CH_3(CH_2)_2SH$	10*
1 - Butanethiol	$CH_3(CH_2)_3SH$	10*
1 - Pentanethiol	$CH_3(CH_2)_4SH$	10*
1 - Hexanethiol	$CH_3(CH_2)_5SH$	10*
2 - Methyl - 1 - propanethiol	$(CH_3)_2CHCH_2SH$	10*
3 - Methyl - 1 - butanethiol	$(CH_3)_2CH(CH_2)_2SH$	10*
Mercaptosuccinic acid	$HOCOCHSHCH_2COOH$	2*
Sulfide Compounds		
Sodium sulfide	Na_2S	0.8**
Ethyle sulfide	$(C_2H_5)_2S$	25*
Methyl ethyl sulfide	$CH_3SC_2H_5$	25*
Allyl sulfide	$(CH_2{:}CHCH_2)_2S$	25*
Phenyl sulfide	$(C_6H_5)_2S$	25*
Methyl disulfide	CH_3SSCH_3	8**
Miscellaneous Compounds		
Thiourea	$(NH_2)_2CS$	0.4**
Thiolacetic acid	CH_3COSH	0.1**

* This concentration causes high chloride values
** This concentration causes low chloride values

have been processing petroleum crudes containing in excess of 1 per cent sulfur[3]. The presence of sulfur compounds in gasoline impairs the antiknock activity conferred by the addition of tetraethyl lead, and also promotes corrosion and sludge formation in stored fuel oils. Therefore, one of the objectives of refining is a reduction in deleterious sulfur concentrations.

The extreme complexity and unknown composition of petroleum crudes, distillates, and wastes cannot be exaggerated. The chemical families reported in some petroleum fractions, in addition to the numerous and miscellaneous hydrocarbons, are various sulfur, nitrogen, and oxygen containing components. Sulfur compounds suspected of being present include: alkanethiols, aromatic thiols, cycloalkanethiols, thiophenes, cyclic sulfides; alkane sulfides, di-, and polysulfides.

A search of the literature[4] on oil refinery wastes disclosed that phenols may be discharged in condensate waters from distillate separators and condensate wastes from catalytic cracking units. Caustics which have been spent in the removal of sulfur and acid substances from the crude oil or subsequent fractions offer another source of phenolic bodies. Associated with the phenols in the discharges may be organic and inorganic sulfides, mercaptans, and naphthenic acids, among other compounds.

Since petroleum embodies countless sulfur and other derivatives, it was decided to investigate the effect which several classes of organic sulfur compounds might exert on the Mohr titration, as the literature on this subject is incomplete.

Experimental Investigation of Interference

Detroit raw or finished (dechlorinated) water was used in the interference experiments. Each batch of water was analyzed by the Mohr, and frequently also by the mercurometric procedure. The chloride values of the raw water found by the two methods agreed within 1 mg./l. on a given day, but single batches of water varied over a range of 6 to 8 mg./l. during the one year period of this work.

Stock solutions of various sulfur compounds in a reagent or practical grade (Eastman Kodak or Matheson, Coleman and Bell products) were prepared in an amount to give an initial concentration of 1000 mg./l. of the compound in Detroit water. Subsequent dilutions of these stock solutions were made with Detroit water, thus maintaining a constant chloride content throughout the experimental work with an individual bathc of water. Aqueous solutions of the mercaptans and sulfides were prepared daily to obviate the pronounced changes in composition attendant upon standing.

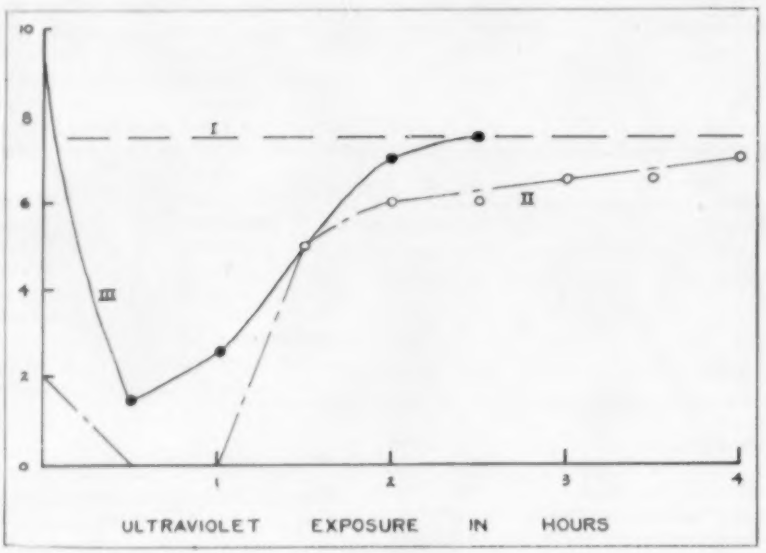
Where aqueous insolubility of the organic compound posed a problem, a stock solution of the organic compound was prepared in 95 per cent ethyl alcohol in a concentration of 1 ml. equal to 10 mg. of the compound. This stock solution was added in the required volume to Detroit water with vigorous magnetic stirring.

When sulfur compounds of an acid nature lowered the pH of the Detroit water, sodium or potassium hydroxide was added in sufficient amount to return the hydrogen-ion concentration to the 7-8 region, normal for Detroit water.

The compounds investigated included representatives from several sulfur families suspected of being present in refinery wastes. Because of the greater commercial availability, much of the experimental effort was concentrated on the mercaptans and sulfides.

IRRADIATION effect on chloride concentration determined by Mohr method

VERTICAL scale shows chloride values in mg. per l.



KEY:

Line I. Detroit water alone, chloride = 7.5 mg./l.
Line II. 10 mg/l. Methyl disulfide added to Detroit water.
Line III. 30 mg./l. Mixed aliphatic mercaptans added to Detroit water, composed of 6 mg./l. of each of the following compounds: 1 - propanethiol, 1 - butanethiol, 1 - pentanethiol, 1 - hexanethiol, 2 - methyle - 1 - propanethiol, and 3 - methyl - 1 - butanethiol.

Effect of Ultraviolet Irradiation

Removal of Inorganic Sulfide Interference

Sulfide, a known interfering ion, was added to Detroit water in ascending concentrations to note the effect on the Mohr titration. The yellow chromate color turned brown upon the addition of 0.2 ml. of standard silver nitrate when the sulfide concentration approximated 1 mg./l. sulfide. This interference could be eliminated by exposing the sample to the radiation of a Hanovia Utility Model Quartz Lamp (a product of the Hanovia Chemical and Mfg. Co. of Newark, N. J.) for a period of 5 minutes. In fact, this irradiation, which is predominantly ultraviolet, destroyed 4 mg./l. of sulfide within 10 minutes without any stirring of the sample.

Table 2 shows that sulfide concentrations exceeding 4 mg./l. are more resistant to the influence of ultraviolet irradiation. The distance of the sample from the lamp materially affects the speed with which the sulfide is dissipated.

Organic Sulfur Compounds

During the early stages of this in-

vestigation, it became evident that organic sulfur compounds are variable in their interference responses. At strengths of 500 to 1000 mg./l. some sulfur compounds impart a brown muddy color to the chromate indicator before the addition of any silver nitrate solution. Organic sulfide compounds manifest both positive and negative interference. Aliphatic mercaptans constitue another class of sulfur compounds interfering in the Mohr titration. The effect exerted by mercaptans on the Mohr titration is cumulative.

The dissipation of the interference by means of ultraviolet irradiation is presented in Fig. 1. The steps by which ultraviolet light degrades mercaptans are subject to conjecture. Efforts to demonstrate the evolution of hydrogen sulfide or inorganic sulfide by means of the methylene blue colorimetric test failed during the course of the ultraviolet irradiation. The absence of inorganic sulfide does not preclude the possibility of the formation of organic disulfides. The following typical equation is cited[5,6] for the air oxidation of mercaptans.

$$2RSH + O \rightarrow RSSR + H_2O$$

where R represents the alkyl group.

Experiments with various methyl disulfide dilutions confirmed that this compound can contribute a significant interference to the Mohr titration by inducing premature endpoint colors. As depicted in Fig. 1, the interference conferred by small amounts of methyl disulfide can likewise largely be removed by ultraviolet irradiation. Curves generally similar in nature to Fig. 1 are provided, following ultraviolet irradiation, by the individual aliphatic mercaptans making up the composite mixture.

According to standard textbooks[6], mercaptans are capable of eventual oxidation to sulfonic acids. Whether this statement applies to ultraviolet irradiation was not checked thoroughly in the course of this work. The ultraviolet light induced a negative interference by generating what was presumed to be various disulfide compounds. The interference was eliminated by continued irradiation.

The heat factor in the irradiation experiments was minimized by immersing the sample beaker in a sink filled with water flowing from the tap, thereby insuring a uniform temperature of 25°C. Throughout this series of experiments, the sample volume was maintained at a constant 1 liter volume in a standard 1.5 liter pyrex beaker with the brim of the lamp hood resting on the rim of the beaker. Whenever a withdrawal was made for analysis, a corresponding amount of the original but unirradiated solution was added to restore the initial level.

Sulfides and mercaptans represent recognized refinery products. A cursory screening of several additional compounds indicated that other sulfur-bearing groups were capable of interference in trace amounts (Table 3). Thiourea and thiolacetic acid exerted a powerful influence on the Mohr titration by virtue of a brownish color produced with standard silver nitrate. One hour of ultraviolet irradiation was sufficient to discharge the interference caused by 1 mg./l. of thiourea or thiolacetic acid.

Interference of Naphthenic Acids

Naphthenic acids are purported to exist in petroleum crudes[4]. Tests with an Eastman Kodak naphthenic acids product, boiling point range 160-198°C. at 6mm., showed an interference in the Mohr titration when the acid concentrations approached and exceeded 100 mg./1. The interference took the form of a premature orange color upon the addition of standard silver nitrate.

Evaporation Removes Some Interefernce

A composite was prepared using Detroit water containing 100 mg./1. of each of the following mercaptans and organic sulfides: 1-butanethiol, 1-pentanethiol, 1-hexanethiol, 2-methyl-1-propanethiol, 3-methyl-1-butanethiol, ethyl sulfide, methyl ethyl sulfide, allyl sulfide, and phenyl sulfide. No interference developed in the Mohr method when 50 ml. samples of this 900 mg./1. composite were evaporated to dryness over a steam or boiling water bath and the solids redissolved in 50 ml. of distilled water prior to titration.

The evaporation process will satisfactorily dispose of interference from such volatile and thermally unstable compounds as mercaptans and sulfides. Stable compounds of a type represented by thioures and the potassium salts of mercaptosuccinic acid and thiolacetic acid, which resist decomposition upon heating, continue to interfere in the Mohr titration, even after evaporation. Sample evaporation, therefore, is no cure-all.

A procedure found satisfactory for coping with limited concentrations of mercaptosuccinic acid (50 mg./1.) was to evaporate the sample to dryness over a steam or boiling water bath. Using a glass stirring rod, the residue was then rubbed with 0.5 ml. of 30 per cent hydrogen peroxide to insure complete contact with the solids and the evaporation was repeated over the steam bath. Titration followed in the normal manner after the residue was dissolved in 50 ml. of distilled water.

These approaches probably represent the simplest solution to the interference problem available to most laboratories. Evaporation has the advantage over ultraviolet irradiation in that higher interference levels of sulfur compounds can be removed with certainty in a shorter time.

Discussion of Results

A direct test for a vital chemical component is unquestionably to be preferred in the field as well as in the laboratory. However, time, space, and equipment may militate against the adoption of the direct test for field work. In such an event, the intelligent use of rapid indirect tests can serve a practical purpose.

An understanding of the particular pollution situation is required for the application of indirect tests. For example, it is known that sulfur compounds can be present in improperly treated oil refinery wastes. Furthermore, phenols often may occur in the same discharges. By testing directly for the sulfide, or, in the case discussed in this report, by noting the interference in the Mohr titration and the appearance of the brown floc upon the addition of copper sulfate preservative, it was possible to spot the slugs of abnormal amounts of the accompanying phenols at the moment of entrance into the stream.

There is no intent here to recommend or suggest that interference justifies the abandonment of a principal determination. The important point is that an interference in a chemical test need not be regarded with a jaundiced eye. Interference can, in fact, be turned to an advantage under certain circumstances, depending on the point of view and the interpretation of the results.

The continuing development and use of new compounds by industry necessitates the constant re-examination of accepted analytical procedures for evidence of interference. Recent industrial history indicates that laboratory curiosities can suddenly mushroom into mass-production materials, synthetic detergents representing an obvious case in point. The usual course is to wait until a dramatic departure from norm occurs in a routine determination before an inquiry is launched into the situation. Thus was the interference of various organic sulfur bodies in the Mohr titration discov-

ered. Further investigation showed that ultraviolet irradiation or sample evaporation could largely dispel the interference from some of these sources.

Acknowledgment

The field investigations on which this paper is based were made under the general direction of the following officials of the Detroit Department of Water Supply: Messrs. L. G. Lenhardt, General Manager; W. M. Wallace, Superintendent of Filtration and Sewage Treatment; and Douglas Feben, Assistant Superintendent of Filtration. The analytical data were gathered with the technical assistance of Messrs. Sidney Feldsteen, Thomas Myers, and William Redman, Sanitary Chemists of the Detroit Department of Water Supply.

References

1. Report of the International Joint Commission, United States and Canada, on the Pollution of Boundary Waters. Washington, Ottawa, 1951, p. 170.

2. *Standard Methods for the Examination of Water and Sewage.* Am. Pub. Health Assn. and Am. Water Works Assn., New York (9th ed. 1946), p. 73.

3. Eleven Articles in Symposium on Sulfur in Petroleum. *Industrial and Engineering Chemistry,* 41:2680-2741 (Dec., 1949).

4. Rudolfs, W. editor. *Industrial Wastes, Their Disposal and Treatment.* Reinhold Publishing Corp., New York (1953), pp. 419-449.

5. Gilman, H. editor. *Organic Chemistry, An Advanced Treatise.* Volume I. John Wiley and Sons, New York (1943), p. 85.

6. Conant, J. B. *Chemistry of Organic Compounds.* Macmillan Co., New York (1933), pp. 271-273.

W&SW

St. Louis Sewer District Adopts New Construction Code

Copies of the Metropolitan St. Louis Sewer District's new public sewer construction code recently were sent by the district to public officials, engineers, contractors and subdividers throughout the area affected. The code, recently adopted by the Metropolitan Sewer District's Board of Trustees, became operative July 25.

The 20-page document establishes for the first time uniform construction specifications for pipe sewers throughout the Metropolitan Sewer District, which includes about 222 square miles consisting of all the city of St. Louis and approximately one-third of St. Louis County.

The code covers sanitary and storm sewer construction. It is divided into the following four main sections: Excavating, Pipe Sewer Construction, Manholes and Inlets, and Manufacture of Concrete.

Oil Membrane Filter May Convert Ocean Water

Dr. Gerald L. Hassler, engineering lecturer at the University of California at Los Angeles, has developed a pilot machine which he believes can convert sea water into fresh water economically through pressurized osmosis.

Development of the machine was supported by the saline water conversion division of the U. S. Department of the Interior.

A converter about the size of an ordinary hot water tank, containing a cubic yard of membrane, is believed capable of producing about 1000 gallons of fresh water a day.

The membrane is a thin film of oil held between two thin plastic sheets. Sea water is vaporized under pressure and filtered through the oil film.

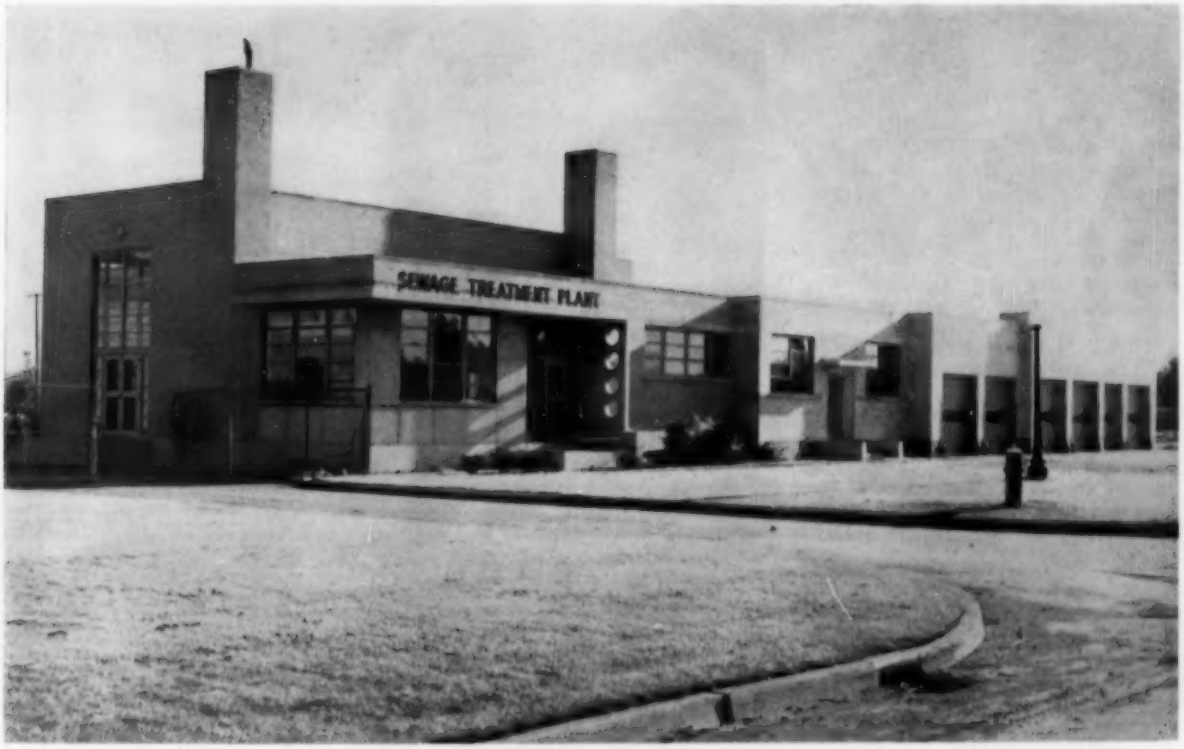
$59 Million in Municipal Sewage Treatment Contracts Awarded for 169 Projects in First Quarter

Construction contracts for 169 projects to aid in stream pollution abatement through providing treatment of sewage from municipalities, institutions, and other significant population centers, were awarded by U. S. cities during the first quarter of 1955, according to reports recently made by the USPHS. The contracts, totaling $59 million, covered 72 new plants and 97 additions, enlargements, or improvements to existing plants.

Of the 72 new plants, costing $24.3 million, only four were for places of more than 25,000 population — San Jose, Calif., Cumberland, Md., Cincinnati, Ohio (part of Millcreek plant), and Petersburg, Va. These four plants accounted for 36 percent of the total new plant cost. More than one-half (48) of the new plants will serve places of fewer than 5,000 population. Both the number and the dollar value of contracts for the first quarter of 1955 are substantially the same as for the previous quarter, but are about 25 percent higher than for the comparable period of 1954. A breakdown of the projects is given in the accompanying table:

Sewage Treatment Plan Construction Contract Awards During First Quarter 1955

Drainage Basin	Types of Construction: New Plants		Additions, Enlargements, Replacements, Etc.		Total	
	No.	$1000	No.	$1000	No.	$1000
Northeast	1	408	9	2,049	10	2,457
North Atlantic	13	3,432	19	4,523	32	7,955
Southeast	5	1,186	8	2,789	13	3,975
Tennessee	....	.....	1	368	1	368
Ohio	11	8,155	6	2,704	17	10,859
Lake Erie	....	.....	....	.....	.....	.....
Western Great Lakes	3	560	9	14,860	12	15,520
Upper Mississippi	16	3,693	12	2,287	28	5,980
Missouri	6	1,376	6	1,005	12	2,381
Southw.-Lower Miss.	6	816	5	542	11	1,358
Western Gulf	2	142	4	1,698	6	1,840
Colorado	4	99	2	351	6	450
Great Basin	1	137	....	.....	1	137
California	3	4,217	16	1,549	19	5,766
Pacific Northwest	1	53	....	.....	1	53
United States	72	24,273	97	34,725	169	58,998



SEWAGE TREATMENT plant at Mt. Clemens, Michigan, houses completely equipped water meter testing and repair shop.

Sewer Service Charges Based on Metered Water Use Becoming More Common

by JOSEPH S. ROSAPEPE

Mr. Rosapepe is Account Executive with the advertising and public relations firm of Dudley, Anderson & Yutzy. In this article he reviews briefly the advantages of basing sewer service charges on metered water use and cites some specific examples where the method has been successfully applied.

SEWER SERVICE CHARGES based on metered water use are becoming more common as more communities seek to establish an equitable system of payment for sewage treatment.

The trend toward setting sewer service charges on the basis of water consumption results from the recognition that most water distributed through a city's system eventually reaches the sewer system.

This practice is accepted as theoretically ideal because the sewer service charge is based on the volume of sewage contributed. In metered communities adoption of such charges is not difficult. Sewer charges based on metered water readings are simple enough to understand, easy to apply, and fair enough to be acceptable to the people in each community.

Charges can be expressed as a percentage of the water bill or as rates based on water consumption. Generally, the sewer rate is lower than the water rate. In some cases the water and sewer rates are combined into a single rate.

Setting of sewer rates based on metered water consumption "is coming to be the most popular and possibly the most equitable system of levying sewer charges," according to George H. Esser, Jr., Assistant Director of the Institute of Government of the University of North Carolina.

Advantages listed by Mr. Esser for sewer rates based on metered water consumption are as follows:

1. General practicality;
2. Smaller cost of billing and collecting sewer charges;
3. Greater convenience to the customer;
4. Closer relation of sewer use to water consumption;
5. Effective means of enforcing sewer charges by cutting off water for non-payment of the sewer service charge.

In his study of sewer charges, Mr. Esser was particularly concerned with

the equitable level of rates adopted. He said:

"While sewer charges are a valid and lucrative source of revenue in financing the construction and operation of sanitary sewer systems and sewage treatment plants, rates should generally be readjusted somewhat in line with the principle recommended in the joint report issued by committees of the American Society of Civil Engineers and the American Bar Association."

This joint report stated:

"The needed total annual revenue of a water or sewage works shall be contributed by users and non-users (or by users and properties) for whose use, need and benefit the facilities of the works are provided approximately in proportion to the cost of providing the use and the benefits of the works."

This principle is reflected in the changing methods of setting sewer charges. Originally such charges came into being as a relief to the burden of the real estate tax, but in most cases were set on a flat-rate basis.

Puts Sewage Disposal on Self-Supporting Basis

Currently the trend toward charges based on metered water use is being speeded up by the goal of putting sewage disposal on a self-supporting basis. This, in effect, follows the pattern of what metered rates have done for water service.

A 1954 report by Floyd Browne and Associates, consulting engineers of Marion, Ohio, recommended a sewer service charge for construction of sewage disposal plant and a related network of interceptor sewers in Niles, Ohio, based on metered water use.

According to the report, such service charge to defray costs of revenue bonds is the preferred system used by municipalities today.

The report pointed out that a number of methods have been used to determine sewer charges — number of people in a household, sanitary fixtures per dwelling, number of factory employees, flat rates, or size of water meter or connection.

"All of the above methods are rapidly being superseded by the use of a rate based on water consumption," the consulting engineers' report said.

Among cities which use metered water rates for setting sewer charges are: Elkhart, Ind.; Bayonne, N. J.; Salem, Va.; South Bend, Ind., and others.

CLOSE RELATIONSHIP between water consumption and sewage disposal is further emphasized in Mt. Clemens, Michigan, where both functions are clearly identified on utility vehicles.

MOUNT CLEMENS WATER AND SEWAGE DISPOSAL BILL

NET AMOUNT PAYABLE ON OR BEFORE DUE DATE
PHONE HO 8-5801
If not paid by 20th of the month service will be discontinued

METER READING		DUE	USED
PRESENT	PREVIOUS	DATE	
GROSS	NET	CODE	

CITY BUSINESS

Make all checks payable to Mount Clemens City Treasurer and enclose this stub with check.

GROSS	NET	CODE

Rates — Monthly Consumption

	Water	Cu. Ft.	Sewage
1st 500 Cu. Ft.	$1.15		$1.60
Next 1500 Cu. Ft.	.15c	(100)	.27c
Next 4000 Cu. Ft.	.13c	(100)	.23c
All over 6000 Cu. Ft.	.11c	(100)	.20c
Min. charge per month	1.15		1.60

CODE
BL—Balance
CR—Credit
SR—Sewer
WT—Water
MB—Min. Baths
SA—Sanitation

CITY OF MOUNT CLEMENS
WATER, SEWAGE DISPOSAL AND SANITATION BILL

NET AMOUNT PAYABLE ON OR BEFORE DUE DATE
PHONE HO. 8-5801
If not paid by 20th of the month service will be discontinued

METER READING		DUE	USED
PRESENT	PREVIOUS	DATE	
GROSS	NET	CODE	

City Residential

Make all checks payable to Mount Clemens City Treasurer and enclose this stub with check.

GROSS	NET	CODE

RATES—QUARTERLY CONSUMPTION

	Water	Cu. Ft.	Sewage
1st 1500 Cu. Ft.	$3.45		$4.80
Next 4500 Cu. Ft.	.15c	(100)	.27c
Next 12000 Cu. Ft.	.13c	(100)	.23c
All over 18000 Cu. Ft.	.11c	(100)	.20c
Min. charge per month	1.15		$1.60

Code
BL—Balance
CR—Credit
SR—Sewer
WT—Water

SEWAGE CHARGES based on metered water consumption are standard in Mt. Clemens, Michigan. These bills for commercial (upper) and residential (lower) consumers carry the sewage rates and the water rate, expressed in cubic feet.

Niles, Ohio
Times 3/16/54

Plan to Use Meter System To Pay for Sewage Disposal

A sewer service charge for construction of a Niles sewage disposal plant and related network of interceptor sewers, which it is estimated would cost the city $1,156,700, would probably be one based on metered water use.

According to a report released today to Mayor Edward P. Lenney and other city officials by Floyd G. Browne and Associates, consult-, serts of deferred

Galveston, Texas
News 1/19/54

SEWER CHARGE PAYMENT BEGINS; ON WATER BILL

Water consumers are being billed their first time under the new sewer charge which becomes effective on Jan. 1, and there have ...terworks Commissioner Marshall ...er, The News has received numer... mostly in the form of complaints. ...m. 6, and are continuing according ...sending out its notices. ...ised by taxpayers when the $1,700,... tion of a sewerage disposal plant ...d. ...l be paid off through the sewer ...ed for operation and maintenance ...its and replacements, McNeel said. ...oved by the citizens advisory com...

Roanoke, Va.
World-News 4/20/54

Separate Meter for Sprinkling Lawn Will Save Sewer Levy on That Water

Have you been irked over paying the city's 40 per cent sewage department debt assessment on water used for sprinkling lawns?

Then there is an answer.

Buy a second water meter and install it for [illegible] sprinkling only.

Then the water used for making the grass greener this summer will not be taxed as will be the water that goes down your sewer line.

But there is a catch.

Cost of the meter would be except that it is sprinkling ...

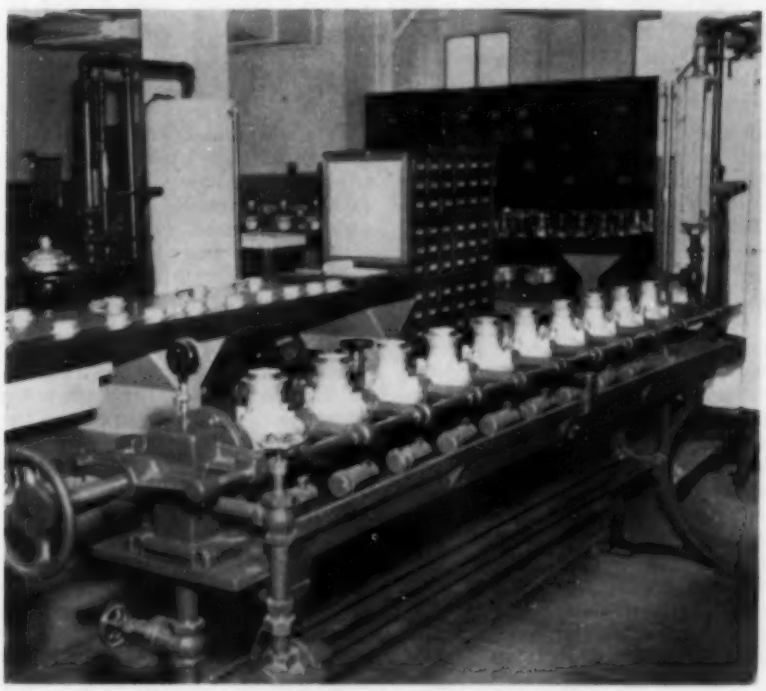
Wheeling, W. Va.
Register 3/3/54

Well-Water Users Pay Sewer Fees by Meter

By CHARLES GALLAWAY
News-Register Staff Writer

If you happen to know of a manufacturing plant that uses water from a well, don't think those plants which discharge clear water which is not contaminated as is the usual water going into the sewer system. Such non-polluted water can be diverted, even if it is purchased ...red a ...ern— ...r the

TYPICAL of the growing trend toward making sewage charges on the basis of metered water consumption are these newspaper headlines.



PROPER MAINTENANCE is recognized as the most important factor in assuring sustained accuracy of meters. This test bench in the meter shop at Van Nuys, California, is typical of the testing facilities in some water systems.

Typical Examples

Typical of the system used in some communities is the practice adopted in Waynesboro, Va., on the recommendation of the engineers for the sewage treatment plant. Users of the city's sewage works since July 1, 1954, are charged 60 per cent of their water bill to service the sewage bonds and maintain the treatment plant.

Users of the sewage works who live inside the corporate limits are charged a minimum of 90 cents. This is set on the basis of the first 1,500 gallons of water. Above that volume the charges are as follows: next 50,000 gallons, 24 cents per 1,000 gallons; next 150,000 gallons, 18 cents per 1,000 gallons; next 200,000 gallons, 12 cents per 1,000 gallons; and over 401,500 gallons, 9 cents per 1,000 gallons.

The rates for users outside the corporate limits are also 60 per cent, although the minimum is $1.80 and the rates per bracket for city users are doubled for each comparative division. This is due to the double rate for water users beyond the corporate limits of Waynesboro.

For private water suppliers, the city ordinance specifies that the amount discharged into the sewers shall be determined by meters provided by the consumer or at the consumer's expense with an applicable rate to be charged.

In Springfield, Ill., sewer charges based on metered water use went into effect in 1954 to pay for a long-range $9,000,000 sewer and sewage disposal improvement program.

The minimum service charges range from $1 per month upward. They are computed on a schedule of rates based on the monthly consumption of water per meter. The charges range from 20 cents per 100 cubic feet of water for the first 3,000 cubic feet to as low as 8 cents per 100 cubic feet for all water in excess of 30,000 cubic feet per month.

When the system was first introduced, the City Council issued a statement which said: "This is not to be interpreted as a raise in water rates. Rather, the system devised is a service charge against users of the sewer system, with billings to be made monthly through the City Water, Light, and Power Department."

At that time the Mayor of Springfield, in a formal statement, said:

"The rate ordinance establishes monthly service rates based on water consumption, computed on a graduated scale so that the heavier water

consumers, who technically also are the heavier users of the sewer system, will pay the greater charges. On the average it is anticipated that approximately one-half of metered properties within the city of Springfield will pay only the monthly minimum of $1."

In Lawrence, Kan., a sewer rate was adopted in 1954 after a $3,000,000 water and sewer improvement bond issue was sold. The Lawrence schedule made outright provision also for disposal of "waste water from non-conserving air conditioning equipment," on the following basis:

For the first 10,000 gallons or less per month, $1.25 per month.
For the next 290,000 gallons per month, at the rate of $0.08 per 1,000 gallons.
Over 300,000 gallons per month, at the rate of $0.04 per 1,000 gallons.

In Fort Branch, Ind., the sewer charge starts with the minimum of $2.50 per quarter, to which is added 30 cents for every 1,000 gallons of water metered over 9,000 for the quarter. For example, a person who uses 12,000 gallons of water a quarter, for his sewage charge pays $2.50 for the first 9,000 gallons with the remaining 3,000 gallons being billed at 30 cents per 1,000 gallons, making a total bill of $3.40 for the quarter.

Galveston, Tex., in January, 1954, joined the cities using this advanced practice of levying sewer charges on the basis of water consumption after taxpayers authorized a $2,700,000 bond issue for the construction of a sewage treatment plant and interceptor line.

Sewer charges for industrial and commercial users, based on metered water bills are: First $5 of water bill, 40 per cent, $2 minimum charge; next $5 of water bill, 35 per cent; next $10 of water bill, 30 per cent; next $30 of water bill, 25 per cent; next $50 of water bill, 20 per cent; next $200 of water bill, 15 per cent; next $300 of water bill, 10 per cent; and next $500 of water bill, 5 per cent.

More Examples

In January, 1954, Boulder, Col., increased its sewer rates and changed from a flat-rate charge to a proportional new sewer service charge system based on the amount of water used during the first quarter of each year.

It was estimated that the new schedule raised the average residential rate from the previous $2.14 a year to $5.47 a year. For all customers, including business places, the average cost went from $3.04 to $7.37, raising the city's revenue for the sewer maintenance fund from $16,300 in 1953 to an estimated $38,000 in 1954.

The annual sewer charge for customers with water meters is 3.5 cents per 1,000 gallons of water used, based on four times the metered water used during the first quarter of the year. Instead of figuring the sewer charge on the amount of water used in each quarter of the year, the charge for each of the four quarters is determined by the water consumption during the first quarter. The minimum sewer charge for metered water customers is $4 a year.

The new schedule provides no separate business rates because all business places have water meters, as do fraternity and sorority houses and the University of Colorado. Charges for customers outside the city limits are double those inside the city.

INDUSTRIAL water consumption contributes substantially to sewage treatment and disposal problems. Here a reading is being taken of a compound meter designed to record both high and low flows.

Perris, Calif., has a minimum charge of 50 cents per building, with a quanitty charge of $1 for each 4,000 cubic feet of sewage flow, which is assumed to be 90 per cent of the water usage unless the user submits evidence to the contrary.

A similar rate, based on consumption, is used in Redlands, Calif., where each business establishment, manufacturing plant and industrial building is charged for each sewer connection. The schedule provides for the following rates: 50 cents for the first 1,250 cubic feet of water used, 75 cents from 1,250 to 2,000 cubic feet, and for each additional 1,000 cubic feet an additional 40 cents.

In Troy, Pa., water and sewer rates were increased early in 1954 to put the city on a better financial basis. In 1953 the Borough water system received about $11,250 in revenue and spent about $14,750 for operation, maintenance and repair, representing a loss of $3,500.

The minimum water rate was raised from $2.50 to $3, affecting 90 per cent of the Borough's water users. When the sewer rates were raised, a large number of users were brought under the $3 minimum use charge. If a water user is charged for more than 6,000 gallons (the minimum), one-half of the water bill in excess of the minimum charge of $3 is collected by the sewer department in addition to the $3 minimum charge for sewer service.

Some Disadvantages and Their Solutions

Despite the strong trend toward levying sewer charges on the basis of metered water consumption, some authorities have pointed to slight disadvantages in this method. These disadvantages are not serious enough, however, to lead to a reversion to flat-rate sewer charges.

Instances are noted where all the water consumed is not discharged into the sewer system, as in the case of lawn sprinkling and bottling of soft drinks. Another factor to be considered is that industrial sewage concentrations are not taken into consideration.

Some authorities say that generally it is best to make exceptions or special provisions for charging such industries as bottlers, ice companies, and those with air conditioning units.

The problem of water used for lawn sprinkling which did not go into the sewage disposal system brought on a unique development in Waverly, Iowa, in the summer of 1954. Utilities Superintendent Glen Yarger reported that he was getting requests for additional meters to be placed on faucets supplying water for gardens and lawns.

He said that the requests resulted from the much higher sewer rates now in effect in Waverly and that such requests came from people who did not want to pay sewer charges for water used on lawns and gardens.

In Marathon City, Wis., where the sewer charges are fixed at one-half the metered water bill, consumers are credited for water used in lawn sprinkling which does not reach the sewer system. Bills for the period from July 1 to September 30 are based on water consumption for the preceding billing period.

The Marathon City ordinance also provides a credit for consumers where a portion of the water used is not discharged into the system. In this case the amount of water deducted in computing the sewer service charge is credited provided a separate meter is installed to record this portion of the water used.

In Wheeling, W. Va., the problem of levying a sewer charge against consumers having their own wells as a supply source was faced in the ordinance providing for the city's new $7,500,000 sewer system.

The ordinance setting up the sewer rates of one and one-half times the water bill did not overlook the customer who gets water from his own well or from any source other than the city water department.

If the water from such a source is not already measured by a meter, the law as proposed requires the owner to install, at his own expense, a meter which will satisfactorily measure the amount of water used so the sewer service charge can be established.

Roy Weston Devotes Full Time to Consulting

Roy F. Weston, Sanitary Engineer of the Atlantic Refining Co., resigned that position on September 1 to devote his full time energies to his consulting firm, Weston, Eckenfelder and Associates.

For the past 16 years, Mr. Weston has been in charge of Atlantic's waste control program. In addition, he has had a broad experience as a consultant on many types of industrial wastes problems.

Mr. Weston is a member of ASCE, AIChE, NSPE, ACS, Pa. S & IWA, and Sigma Xi. He has been active in committee work in the field of industrial wastes for the Amer. Petroleum Institute, Am. Soc. Test. Materials, Interstate Commission on the Potomac River Basin, and in AIChE, ACS, and FSIWA. He is the author of more than 30 articles on the subject of waste-water treatment and is a past president of the Pennsylvania Sewage and Industrial Wastes Association.

Weston, Eckenfelder and Associates, formerly known as Weston, Eckenfelder, and Hood, will maintain two offices. Mr. Weston will be located in the Newtown Square, Pa., office, and Mr. Eckenfelder will be located in the Leonia, N. J., office. The firm will specialize in surveys, research, pilot plant development, process engineering and operation control in the field of water supply, industrial wastewater treatment and air pollution control.

Tisdale Retires from USPHS; To Head Potomac Commission Staff

Ellis S. Tisdale, Sanitary Engineer Director, retired from the U. S. Public Health Service in September after 18 years of service. He has accepted a position as Director of the Interstate Commission on the Potomac River Basin, Washington, D. C.

Mr. Tisdale graduated from Massachusetts Institute of Technology in 1915 with a B.S. degree in sanitary engineering. From 1916 to 1938 he was employed as assistant engineer and then chief engineer with the West Virginia State Health Department. While there, he organized the stream pollution control work of the Ohio River Board of Engineers, a group composed of the chief engineers of the eight states in the Ohio Basin. He was commissioned in the Public Health Service in November 1938, the first sanitary engineer reserve officer in the PHS.

During World War II he was the engineer member of the small faculty of health officials which conducted monthly orientation courses at the National Institute of Health for more than 1,000 new PHS officers. Later he served with the War Manpower Commission, and was a member of a committee planning for joint field operations of the PHS and the American National Red Cross in times of disaster. His latest assignment was as regional engineer at the Atlanta, Ga., office.

Canned Water for Emergencies

Latest in provision of water for emergency use during drought periods is an adaptation of the development of canned water during World War II by the Armed Forces. The idea of canned water has intrigued explorers and sportsmen for many years, and Civilian Defense officials since the advent of the Atomic Era.

The canned water also would be a means of storing small supplies of drinking and cooking water for domestic use in case of main breaks, temporary supply contamination, and other emergencies.

A Basis for a Training Program for Sewage Plant Operators

by THEODORE JAFFE and JOHN P. DAUGHTREY

Mr. Jaffe is Associate Professor of Civil Engineering and Mr. Daughtrey was formerly Instructor, General Extension Division, both of the University of Florida. **Their article is essentially a summary of questionnaire returns from Florida sewage works personnel and the conclusions drawn therefrom as to a workable basis for planning short schools or correspondence courses for such operators.**

AS a result of consideration by the Board of Governors of the Florida Water and Sewage Operators Association to developing a program of correspondence study courses for sewage plant operators, data have been gathered from persons employed in sewage treatment plants throughout Florida. From tabulations of these data, information is presented concerning:

1. The responsibilities and educational levels of the operators.
2. Their duties on the present job.
3. Their training needs for advancement and for better performance on the present job.

Some of the interrelationships of these factors are indicated. A suggested approach by means of such data to a rational planning program for courses of study in this field is offered. Due to the distribution of the replies received it is felt that the sampled group is representative of the over-all field of sewage plant personnel and not restrictive to the portion investigated.

Courses of this type should be consistent with the needs of these employees. These needs in turn, probably would be based on the operators' duties and responsibilities (job classification), their educational backgrounds, and their educational desires. A course of study in a subject for which the operator felt no need, or one for which he did not have an adequate educational background, would serve no purpose. Further, it was recognized that both the needs and the backgrounds of the operators would be varied.

To determine these basic factors the operators were asked, through their Association, to answer a questionnaire prepared by the General Extention Division of the University of Florida. On the information derived from these questionnaires, a series of correspondence courses would be developed.

Information was sought from each operator as to his responsibility and educational level, his duties on his present job, the training he feels he needs to perform his present job and to advance to a higher responsibility.

The Questionnaire

The questionnaire required the operator only to check the applicable answers. Space was allotted for the elaboration of any answer if this was desired. On the first sheet the purpose of the questionnaire was explained and it was emphasized that any information furnished would have no effect on the present job and would not be handled by any except those directly concerned with the survey.

In the first section of the form, general information was requested, such as name and title, length of time on job, certificate held, type of plant and location, and type of treatment provided.

The second section was concerned with the educational background of the operator and the degree of supervision he exercised. It is of interest to note that the operators were also asked whether they were enrolled in any adult education courses. Only ten persons had availed themselves of this opportunity.

The next section listed various duties of a sewage plant operator. The operator was requested to check all the jobs he was required to do. These jobs were divided into three general categories—maintenance, operation and testing.

In the last section, 18 fields of study were listed. The operator was asked to check four columns for those subjects which applied to him. These columns were headed (a) needed on present job, (b) needed to advance on job, (c) have studied at some time, (d) need to refresh, restudy, relearn.

TABLE 1
General Characteristics of Replies

A. Total replies received	163
B. Average age (years)	42.8
C. Educational status (% of replies):	
Less than 6 grades	8.6
Completed 6 grades	9.9
Completed grade school	17.3
Completed grade, but not high school	26.9
Completed high school	28.2
Completed 1 to 4 years college	8.9
D. Time on present job (% of replies):	
Less than 1 year	24.0
1 to 3 years	42.5
4 to 10 years	29.0
Over 10 years	4.5
E. Returns by job title (% of replies):	
Superintendent	14.7
Chief Operator (and "Chief Engineer")	11.1
Operator (and "Engineer")	58.0
Junior, Assistant and Sub-station Operator	8.0
Laboratory Worker	2.5
Maintenance Worker	5.5
F. Returns by certificate (%):	
Holding no certificate[a]	74.3
Holding "C" certificate	20.8
Holding "B" certificate	4.9
Holding "A" certificate[b]	0
G. Returns by type of treatment plant (%):	
Type I, Septic or Imhoff tank	3.7
Type II, Primary Sedimentation	20.3
Type III, Above plus heated digester or vacuum filter	16.0
Type IV, Secondary treatment	59.8

[a] Certification is not compulsory in Florida
[b] Prior to 1953 no examination for the Class A certificate had been given. In 1953, when the A examination was given, two operators passed and received their A certificate.

Survey Data

General Information

The results reported here are based on 163 replies received from the personnel of 51 sewage treatment plants in the State of Florida. It is felt that these persons form a representative sample of the entire group of sewage plant operators in any state where certification is not compulsory, for the following reasons:

1. All types of sewage treatment plants have cooperated.

2. All categories of sewage treatment plant personnel by titles are included.

3. The geographical distribution and town size range is wide. Of the 29 counties having sewage treatment plants, replies were received from 24.

4. The group replying has been on the job from less than 1 year to more than 10 years.

5. The total number of replies received represents about 75 percent of all sewage plant personnel in Florida.

The general characteristics of the sewage plant personnel replying to the questionnaire are summarized in Table 1. These data show that the average Florida sewage plant worker is 42.8 years of age and has had some high school. He has been on the job 1 to 3 years as an operator of a secondary treatment plant. It is significant that with this background he does not have an operator's certificate.

To inquire more deeply into the backgrounds, knowledge, and desires of the sewage plant workers, their replies have been analyzed in greater detail.

Education and Certification

The replies were examined by class of certificate as to the formal schooling involved. From Table 2 several items are of interest. For those holding no certificate, almost as many have had 1 to 4 years of college as have had less than 6 grades of schooling, and the greatest numbers completed grade school. For those holding a class C certificate, the greatest numbers completed high school, and the number having less than 6 grades is extremely small. For those holding a class B certificate, as many have had 1 to 4 years of college as have had no more than 6 grades, and the largest numbers have completed high school.

It is noteworthy that the over-all picture seems to indictate a direct relationship between the amount of formal schooling and the grade of certification achieved (with the exceptions noted).

The replies of persons employed in types I through IV treatment plants showed formal schooling as given in Table 3. Persons of all educational levels are to be found in any of the treatment plants except type I. This seems logical, due to the variety of jobs requiring different levels of schooling.

The data from the type I plants may be partially explained by the fact that since this is generally a "one-man, part time" job a certain restricted range of schooling is most satisfactory to all concerned. The reason for 12 percent of the persons employed in type II plants having had 1 to 4 years of college is not too evident.

Educational backgrounds for each of six key job titles are summarized in Table 4. It seems obvious that those having the higher title have had more education. It is interesting to note that as many chief operators have had less than 6 grades of schooling as have had 1 to 4 years of college.

Job Analysis

To determine the relationships between the various jobs performed in a sewage treatment plant and the men doing these jobs, the replies were analyzed in several groups. The jobs were classified into three major categories—maintenance, operation and laboratory testing. Table V shows the percentage of persons in each job title engaged in these jobs.

A quartile breakdown was made of the job titles doing maintenance, operational and testing tasks, respectively, with each of the three categories further divided into its components. Similarly, a job analysis was made by class of certificate held and by type of treatment plant.

The job analysis by title breakdown shows that there is practically no distinction among the job titles doing maintenance work (except Junior Operators and Chemists). For example, more than 75 percent of the minor repairs are performed by persons of all titles (except laboratory workers). More than 50 percent of persons hold-

TABLE 2

Educational Level by Class of Certificate
(Percentage of Replies)

Education	Certificate		
	None	Class C	Class B
Less than 6th grade	9.9	2.9	12.5
Completed grade school	33.9	8.8	0
Completed grade, but not high school	25.6	32.3	25.0
Completed high school	22.3	38.2	50.0
Completed 1 to 4 years college	7.4	14.7	12.5

TABLE 3

Educational Level by Classification of Plant
(Percentage of Replies)

Education	(Classification of Plant)			
	Type I	Type II	Type III	Type IV
Less than 6 grades	0	11.1	15.4	6.2
Completed grade school	50.0	38.4	11.5	25.7
Completed grade, but not high school	50.0	17.2	26.9	28.8
Completed high school	0	23.2	30.8	29.9
Completed 1 to 4 years college	0	11.1	7.6	9.3

TABLE 4

Educational Level by Job Title
(Percentage of Replies)

Education	Job Title					
	Supt.	Chief Oper.	Oper.	Asst. Oper.	Chem.	Maint.
Less than 6 grades	4.2	5.9	11.7	33.3	0	40.0
Completed grade school	8.3	5.9	34.0	16.7	0	0
Completed grade, but not high school	20.8	47.1	25.5	25.0	0	40.0
Completed high school	50.0	35.3	20.2	25.0	75.0	20.0
Completed 1 to 4 years college	16.7	5.9	8.5	0	25.0	0

TABLE 5

Duties of Sewage Plant Personnel

Title	Maintenance (%)	Operation (%)	Testing (%)
Superintendent	100.0	91.7	91.7
Chief Operator	94.1	100.0	88.2
Operator	98.9	100.0	81.9
Asst. Operator	91.7	100.0	50.0
Chemist	25.0	50.0	100.0
Maintenance	100.0	80.0	40.0

TABLE 6

Jobs Common to All Categories

Maintenance*	Operation	Testing
1. Minor repairs	1. Chlorinators	1. Chlorine residuals
2. Lubrication	2. Pumps	2. Settleable solids
3. Tanks	3. Sludge drawing	
4. Protection of plant and grounds		
5. Inspection and repair of chlorinators		
6. Inspection and repair of pipes and valves		

*Except laboratory workers

ing all titles do the inspection and repair of chlorinators, a somewhat complex and technical job. A similar percentage of persons with all titles are concerned with inspection and repair of pipes and valves, a relatively simple job. Laboratory personnel do no maintenance work.

The breakdowns also corroborate the lack of distinction between duties and titles in the fields of operation and testing. It should be noted that Assistant Operators and maintenance men do very little testing.

On the whole, when the various duties of sewage plant workers are examined by certificate held a more rational pattern may be seen. More than 75 percent of the men having B certificates do the major portion of the jobs, with the percentage decreasing through the C certificate and on to those having no certificate.

The over-all picture obtained is one of greater percentages of B certificate men doing the more complicated jobs, the C certificate men being less concerned with the more complex jobs, the "no-certificate" men being still less concerned with these jobs but more concerned with the less complex ones. However, at the 50 percent level a difference can only be detected for the testing jobs.

It is interesting to note at this point the over-all similarity of jobs performed at all of the plants. For example, the foremost maintenance job in all types of plants is minor repairs; in types II, III and IV plants, the first operational job is pumping; the first testing job in all plants is the determination of chlorine residuals.

Table 6 summarizes the jobs common to all job categories. The jobs listed are performed by more than 50 percent of those replying, regardless of job title, certificate held, or type of treatment provided.

Educational Needs

To determine what subject matter the operators felt they needed to learn, the questionnaire presented a list of 19 fields of study. The operator was asked to check which of these subjects he (a) needed on his present job, (b) needed to advance, (c) had studied, and (d) needed to relearn.

Table 7, the summary of the tabulated replies, indicates that the 163 sewage plant workers replying to the questionnaire have studied the first six subjects at some time and feel that they need to relearn these since they are needed both on their present jobs and for advancement.

Subjects number 7 through 10 could be grouped into those that have been studied, but should be relearned in view of the subjects needed to advance, or are needed on their present jobs. Those subjects appearing in the first and second columns but not in the third (getting along on the job, public health, and bacteriology) have not been studied before but need to be learned.

The question of what subject matter is to be included in any training program may be approached from several philosophies. Should the person be trained for a job title, or to work in a particular type of treatment plant, or so that he may pass an examination for a license or certificate? In a well-planned certification system these approaches may overlap or even be unified.

In an attempt to arrive at the operators' desires from various angles and also to see what differences exist in these three approaches, the results of the questionnaire were analyzed to show the ten subjects most requested by job title, by the type of treatment plant, and by the certificate held (Fig. 1).

On the basis of job titles and type of treatment plant, two subjects—basic arithmetic and sewage calculations — were the first subjects requested and the operators felt these were needed on the job, to advance, have studied and need to relearn. Other subjects requested by a majority of those replying included chemistry, equipment and repair, meters, bacteriology, plant operation, sewage terms, safety, distribution system, equipment operation, hydraulics, and "getting along."

On the basis of certificate held, the men requested sewage plant operation and chemistry first in the same four categories, followed by the other subjects listed, plus electricity, laboratory control and public health.

Many of the "short schools" for sewage operators conducted throughout the country feature sessions on

TABLE 7

Subjects Common to All Categories (in Rank Order)

1. Sewage calculations
2. Basic arithmetic
3. Sewage plant operation
4. Chemistry
5. Terms in sewage
6. Know equipment and repairs

Needed on present job	Needed to advance	Have studied	Need to learn, relearn
7. Equipment operation	Laboratory control	Laboratory control	Safety
8. Safety	Bacteriology	Safety	Equipment operation
9. Getting along on job	Public health	Bacteriology	Meters
10. Public health	Equipment operation	Public health	Laboratory control

TABLE 8
Chemical Analyses Most Commonly Performed[a]

1. Chlorine residuals
2. Settleable solids
3. Dissolved oxygen
4. Suspended solids
5. Total solids
6. Biochemical oxygen demand
7. Volatile solids
8. Acidity[b]
9. Relative stability
10. Oxygen consumed[c]

[a] In order of rank on replies
[b] Probably the pH test
[c] May be calculated from BOD

laboratory analyses. To establish a basis for such courses the Florida sewage works operators were presented with a list of 19 analyses used in sewage treatment plants. They were asked to check all that they were expected to do on their present job. The tests most frequently performed are given in Table 8.

Most of the testing, other than that done by laboratory personnel, is performed by the operator with the following exceptions: Superintendents do most of the bacteriological and ammonia nitrogen tests. Nitrates are run mostly by superintendents and chief operators; while nitrites are mostly by superintendents, chief operators, and laboratory personnel. Type I plants (septic or Imhoff tanks) report doing analyses for chlorine residual, settleable solids, suspended solids and acidity. Type II plants (primary plus unheated digesters) do all analyses except nitrogens. Type III and IV plants (primary plus heated digesters and secondary treatment) do all analyses to some extent.

The implications of Table 9 should be obvious. Depending upon the objectives of the laboratory sessions of any short school, the technical material to be presented should be evaluated. If the men are to be trained to do their present jobs, then only four analytical procedures should be taught to type I plant personnel, etc. If the men are to be taught laboratory procedures needed for advancement to a more complex type of treatment plant, other analyses should also be taught, based on Table 9. It serves no purpose to teach a group of men from Imhoff or septic tank installations how to run all the nitrogen analyses, for example, when they will never need this information on their jobs, nor could they interpret the results if they could obtain them.

It is evident that the analyses per-

Fig. 1—Subjects Requested

		Basic Arith.	Calculations	Distr. System	Meters	Chemistry	Equip. & Repair	Terms	Plant Oper.	Safety	Bacteriology	Equip. Oper.	Hydraulics	Getting Along	Electricity	Lab. Control	Coll. System	Public Health
(a) BY JOB TITLE																		
On the Job	Supt.	√	√	√	√	√	√	√	√	√	√							
	Ch. Oper.	√	√	√	√	√	√	√	√			√	√					
	Oper.	√	√	√	√	√	√		√	√			√	√				
	Jr. Oper.	√	√	√	√		√		√	√		√		√	√			
	Lab. Wkr.	√	√	√	√	√		√		√			√	√		√		
	Maint.	√	√	√			√			√		√		√	√	√	√	
To Advance	Supt.	√	√		√	√	√	√			√	√	√					
	Ch. Oper.	√	√			√	√	√	√	√	√	√	√					
	Oper.	√	√	√	√	√	√	√	√		√		√					
	Jr. Oper.	√	√	√	√	√	√	√			√			√	√			
	Lab. Wkr.	√	√	√	√	√	√	√	√			√	√					
	Maint.	√	√			√	√	√			√							
Have Studied	Supt.	√	√	√	√	√	√	√	√		√	√						
	Ch. Oper.	√	√		√	√	√	√	√			√	√		√			
	Oper.	√	√	√	√	√	√	√	√	√		√						
	Jr. Oper.	√	√	√	√	√	√			√	√	√			√			
	Lab. Wkr.	√	√			√	√	√		√	√							
	Maint.	√	√			√	√											
To Learn	Supt.	√	√	√		√		√	√		√	√	√		√			
	Ch. Oper.	√	√		√	√	√	√	√	√	√	√	√					
	Oper.	√	√		√	√	√	√	√	√		√	√					
	Jr. Oper.	√	√	√	√	√	√			√	√		√		√			
	Lab. Wkr.	√	√			√	√	√		√	√				√	√	√	
	Maint.	√	√			√												
(b) BY TYPE OF PLANT																		
On Job	Type II	√	√		√	√	√	√	√			√					√	√
	Type III	√	√				√	√	√	√	√	√		√		√		
	Type IV	√	√			√	√	√	√	√		√		√				√
To Ad.	Type II	√	√	√		√			√		√	√		√		√		√
	Type III	√	√		√	√	√	√	√	√	√					√		
	Type IV	√	√			√	√	√	√		√	√				√		√
St'died	Type II	√	√		√	√	√		√	√						√	√	√
	Type III	√	√			√	√	√	√		√	√		√		√		
	Type IV	√	√		√	√	√	√	√	√		√						√
To L'rn	Type II	√	√		√	√	√		√	√			√		√	√		
	Type III	√	√			√	√	√	√	√	√				√	√		
	Type IV	√	√		√	√	√	√	√	√						√		√
(c) BY CERTIFICATE HELD																		
On Job	None	√	√			√	√	√	√	√		√		√				√
	Class C	√	√		√	√	√	√	√	√	√	√		√				
	Class B	√	√			√	√	√	√	√		√		√	√	√		
To Ad.	None		√		√	√	√	√	√		√	√				√		√
	Class C	√	√		√	√	√	√	√		√					√		√
	Class B	√			√	√			√		√		√		√	√		√
St'died	None	√	√	√		√	√	√	√	√		√						√
	Class C	√	√	√		√	√	√	√		√	√				√		
	Class B	√	√			√	√	√	√	√	√	√	√					
	None		√		√		√	√	√	√	√	√				√		√
	Class C	√	√		√	√		√	√	√	√					√		√
	Class B				√	√		√	√		√		√	√	√	√		√

TABLE 9

Chemical Analyses Performed by Sewage Treatment Plants

Analysis	Percentage of Plants Doing Analysis			
	Type I Plant	Type II Plant	Type III Plant	Type IV Plant
Bacterial	.....	15.4	80.0	26.7
Tot. solids	.....	46.2	100.0	60.0
Vol. solids	.....	7.7	80.0	53.3
Chlor. res.	75.0	76.9	100.0	80.0
Vol. acids	.....	7.7	40.0	13.3
BOD	.....	15.4	60.0	60.0
Settl. sol.	25.0	76.9	100.0	83.3
Sludge index	.....	23.1	80.0	40.0
D. O.	.....	23.1	60.0	63.3
Rel. stab.	.....	23.1	40.0	43.3
Susp. solids	25.0	38.5	100.0	66.7
Acidity	25.0	30.8	80.0	33.3
Oxyg. cons.	.....	15.4	40.0	33.3
NH_3N	.....	.....	40.0	6.7
NO_3N	.....	.....	40.0	3.3
NO_2N	.....	.....	40.0	6.7
Grease	.....	7.7	60.0	16.7
pH	.....	15.4	60.0	26.7

formed at any sewage treatment plant will be basicaly those required by the State Board of Health or other supervisory governmental agency. No doubt these requirements have influenced many of the results reported here.

On the other hand, any analytical work performed in a sewage plant must be suited to the type of treatment employed therein, regardless of the minimum requirements of the regulatory body. For example, dissolved oxygen tests on the mixed liquor of an activated sludge plant are a necessary control procedure. This same test is not necessary as a control measure in a primary treatment plant, and probably would not be required on the submitted report of either plant.

Discussion

The primary objective of this study was to determine what subjects sewage plant operators felt they needed to learn, based on their job requirements. The data presented can be utilized in several ways to accomplish the ultimate objective—that is, the preparation of study courses. For example, a course of study could be set up (a) for each of the job titles normally found in a sewage treatment plant; (b) to enable operators to meet certain certification requirements; and (c) on the basis of type of treatment plant.

To determine what subjects should be incorporated into a series of courses, the information presented in the individual tables can be compiled as in the illustrative example for the sewage plant superintendent (Fig. 2). A similar scheme could be set up on the basis of (b) or (c) above and for any of the subcategories in each of these; for example, the operator in a type II plant, based on what he does on the job (Fig. 3). The material in each course would be presented at an appropriate educational level as determined from the tables.

If it is desired to present subject matter to all operators regardless of any classification system, Table 7 should be of value as a guide, the presentation, of necessity, being scaled down to grade school level.

These data can be utilized for various other purposes. For example, if it is planned to give courses in laboratory procedure, Table 9 could be integrated with job titles, type of treatment plant, etc., to suit the course to the specific objective.

The material presented by a survey such as that described herein could be used as a basis for certification requirements. For example, if it is desirable to set up a correlation between license or certificate and type of treatment plant, the data on duties and analyses by type of plant should prove of value.

Fig. 2—Integration by Job Title

Sewage Plant Superintendent

Duties[a]			Courses Needed	
Maintenance	Operation	Testing	On Job	To Study
Inspect and repair chlorinators	Pumps	Settleable solids	Basic arithmetic	
Minor repairs	Chlorinators	Chlorine residuals	Calculations	
Inspect and repair pipes and valves	Daily log	Total solids	Distribution Systems	
Major repairs	Digesters	Suspended solids	Chemistry	
Lubrication	Sludge drawing	B.O.D.	Terms	
Upkeep of plant and grounds	Sludge disposal	Dissolved oxygen	Plant operation	
Protection of plant and grounds	Scum	Volatile solids	Bacteriology	
Tanks	Lift stations		Meters	Equipment operation
Inspect and repair meters	Recording		Equipment and repairs	Hydraulics
			Safety	Electricity

Level of material presentation[c] = High School Graduate

[a] From Tables 6 and 8 [b] From Table 7 [c] From Table 3

Summary

The information presented in this report on a total of 163 replies received from all parts of Florida, representing all types of sewage treatment processes and plants, is summarized as follows:

1. The average Florida sewage plant worker is 42.8 years of age and has had some, or has completed, high school. He has been on the job 1 to 3 years as an operator of a secondary treatment plant.

2. Although a large percentage (74.3 percent) of these men hold no

operator's certificate, formal schooling appears to bear some small relationship to the grade of certification held by the remainder.

3. Educational achievement shows no correlation with the type of treatment plant in which employed.

4. There is some evidence that those with higher job titles have had more schooling; this formal schooling decreases as the job titles decrease in responsibility. The exception to this involves those classified as laboratory workers who, as a group, have the highest educational levels.

5. Analysis of job titles reveals that the distinction among the various titles is not clear. For example, some class I plants employing one person call him a superintendent, whereas class IV plants employing nine persons also have a superintendent. Further, job titles and job responsibilities are incompatible. For example, the superintendents do 91 percent of the minor repair work in their plants.

6. When duties are examined on the basis of certificate held, a more rational pattern can be seen, ranging from the "B" certificate people doing the more complicated jobs, down to the "no" certificate people doing the less complicated jobs.

7. The duties and work to be done in most types of treatment plants are very similar, up to a certain point. Regardless of the treatment process, be it simple or complex, the foremost job in maintenance is minor repair; in operation it is pumping; in testing, the determination of chlorine residuals.

8. The operators have chosen six subjects that they need to learn or relearn; have studied at one time; need on their present job; and also to advance. These are (in order of rank): (1) sewage calculations, (2) basic arithmetic, (3) sewage plant operation, (4) chemistry, (5) sewage terminology, and (6) knowledge of equipment and repairs.

9. A guide to subjects requested under the four categories stated above, according to title, type of treatment plant, and certificate, is presented in Figure 1.

10. Chemical analyses performed in sewage treatment plants have been tabulated. Most of the analytical work is performed by persons having an "operator" classification. These analytical procedures have been classified as to frequency, title of persons performing analyses, and type of treatment plant. This information should be of value in planning "short schools" for the operators.

11. The information gathered by a survey of this type can be utilized as a basis for a planned training program. Typical programs have been set up as illustrations (Figs. 1 and 2).

12. Other, related uses of this type of data have been indicated.

Fig. 3—Integration by Type of Plant Operator in a Primary Treatment Plant (Type II)

Duties[a]			Courses Needed[b]	
Maintenance	**Operation**	**Testing**	**On Job**	**To Study**
Minor repairs	Pumps	Chlorine residual	Plant operation	
Inspect and repair pipes and valves	Sludge drawing	Settleable solids	Equipment and repairs	
Upkeep of plants and grounds	Sludge disposal		Basic arithmetic	
Inspect and repair chlorinators	Digesters		Calculations	
Lubrication	Chlorinators		Chemistry	
Tanks	Daily log		Meters	
Protection of plants and grounds	Lift stations		Equipment operations	Safety
Screens	Recording		Terms	Labortory control
Grit chamber	Scum		Collecting systems	Electricity
			Public health	Hydraulics
Level of material presented[c] = Grade School Graduate				

[a] From Tables 6 and 8 [b] From Table 7 [c] From Tables 3 and 4

Acknowledgments

The authors wish to express their appreciation to Professor John E. Kiker, Jr., and other members of the Civil Engineering staff for their criticism of this manuscript and to the members of the Extension Division for their assistance with the questionnaire. They are especially grateful to the individual plant workers who replied to the questionnaire, without whom this report could not have been accomplished.

Indian Sea Salt Provides Natural Fluoride Requirements

Fluoride in table salt may serve to reduce tooth decay much as fluoride in drinking water does, reports Dr. James H. Shaw, Assistant Professor of Dental Medicine at the Harvard School of Dental Medicine.

In a paper submitted to the annual meeting of the American Societies for Experimental Biology in San Francisco, Dr. Shaw discussed the healthy teeth of residents of Delhi, India. He commented on their use of sea salt, which contains natural fluorides and other elements.

Analysis of teeth extracted in a Delhi dental clinic showed the average fluoride content in the enamel and the dentin to be 0.03 and 0.07 percent, respectively. Both levels are sufficient to retard decay.

Use of a mixture of salts prepared by evaporation of sea water, Dr. Shaw believes, may be the answer to their low susceptibility to tooth decay. He estimated that the incidence of tooth decay among the people of India was about one-third to one-fourth that of the people in the United States.

According to Dr. Shaw, Indian sea salt, which is prepared from sea water and is not further processed, evidently supplies as much fluoride as would be supplied by drinking water containing between 2.5 and 3.5 parts of fluoride per million parts of water. He said that this is one of the first major evidences that fluoride-containing substances other than water can aid in the prevention of dental caries.

The possibilities that other trace elements found in the sea salt consumed by the people of India may also have a bearing on the rate of tooth decay, were not ruled out by Dr. Shaw. He noted, too, that American table salt is nearly devoid of trace elements, except where iodine is added.

SEWAGE WORKS PRACTICES

Organic Solids in Sewage

Series 2—Part 3

by DON E. BLOODGOOD

Mr. Bloodgood is Professor of Sanitary Engineering, Purdue Univ., Lafayette, Ind. In this series, he discusses *Sewage Works Practices* in the form of short course lectures. These are designed to assist plant operators, students, and all who wish to review fundamentals in this field.

IN THE third installment[1] of the first series of these articles the topic discussed was "Organic Solids in Sewage Treatment." In the article the three classifications of organic solids —carbohydrates, proteins and fats— were discussed. A few illustrations of each were given and the transformation of the carbon, nitrogen, and sulfur in the three cycles was described.

A more detailed description of the complex reactions that must take place in biochemical decomposition of organic sewage solids will be undertaken in this article.

Carbohydrates

Carbohydrates are important constituents of most plants. In fact, they comprise about 75 percent of the dry weight of most plants. The sugars serve as available energy, the starches as stored food, and the cellulose as structural material. These compounds are formed by living cells in their use of the radiant energy from the sun.

Gortner[2] gives a classification of carbohydrates which is given in part in Table 1. Many of these compounds are found in sewages or industrial wastes. Table 1 serves as an illustration of the great number of carbohydrate compounds and the complexity of each.

The carbohydrates when acted upon by microorganisms undergo chemical changes. The various metabolic processes have been studied quite intensively in the past several years, but only a few of the investigations have been in the field of sewage treatment. The studies in other fields on enzymology and biological oxidation and reduction have brought about some trial applications in sewage and industrial waste treatment.

It is reported that the metabolism of carbohydrates is similar in man, plants and organisms. It is, therefore, reasonable to try to accomplish the end results of metabolic processes in waste treatment if they are known to be possible in one of the three groups previously mentioned.

The utilization (in sewage treatment it is destruction) of carbohydrates results in the release of energy for microorganisms. In this process of decomposition a series of chemical reactions must be carried out with the aid of specific enzymes and coenzymes. In the use of carbohydrates in metabolic processes some of the constituents liberated may be used in the production of fats and proteins.

Carbohydrates can be broken down anaerobically or aerobically, but in the anaerobic decomposition of glucose, for instance, the release of energy is only a small portion of that available. Much more energy is released if the decomposition takes place aerobically.

Decomposition of glucose by either anaerobic or aerobic means results in the formation of pyruvate. In the next step in the anaerobic decomposition the pyruvate is reduced to lactate, whereas in the aerobic decomposition pyruvate is oxidized to carbon dioxide and water. In the case of glucose a phosphate ester must be synthesized before it can be converted to the pyruvate by cellular enzymes.

From this very brief and incomplete discussion of the metabolism of one of the many sugars it can be ascertained that in order to decompose one of the simplest of sugars, many com-

SOME organic sewage solids are removed in the grit chamber, but most of these are washed back into the plant flow

TABLE 1

Classification of Carbohydrates

I. Simple Sugars
   1. Dioses
   2. Trioses
   3. Tetroses
   4. Pentoses
   5. Hexoses
   6. Heptoses
   7. Octoses
   8. Nonoses
   9. Decoses

II. Oligosaccharides or Compound Sugars
   1. Pentose-hexose saccharides
   2. Trisaccharides
   3. Tetrasaccharides

III. Polysaccharides
   1. Nutrient polysaccharides, starch, glycogen
   2. Pectins, plant gums and mucilages, hemicelluloses
   3. Skeletal polysaccharides, cellulose, chitin

plicated reactions involving chemicals and specific enzymes are required.

Sugars can be used by many microorganisms as a source of food, but there is a great difference in the kind of sugar required by a particular organism. Specific organisms use one kind of sugar and a different organism will be required if another type of sugar is to be decomposed.

In the utilization of sugars without ample oxygen the reaction is incomplete and compounds other than carbon dioxide and water are formed. With the most efficient mixed culture, the reaction in the decomposition of sugar by anaerobic organisms can be expressed as:

$$C_6H_{12}O_6 \rightarrow 3\,CH_4 + 3\,CO_2$$

the carbon dioxide and methane being the common constituents in gas from the decomposition of sewage solids.

The more stable carbohydrates (such as cellulose, lignin and tannin) are more difficult to decompose, but they apparently are decomposed to some extent.

Proteins

Proteins contain hydrogen, oxygen, carbon, nitrogen and sulfur, but the methods of analysis available to the chemists for the determination of these elements have not sufficed for the determination of a particular kind of protein. In fact, the chemical composition of nearly all of the proteins is still unknown. The classifications that do exist are based upon the chemical behavior, solubility, or peptization (the changing into a colloid) of the proteins.

Protein materials are believed to make up a considerable portion of the solids found in sewage. The nitrogen content of primary sludge is reported by Babbitt[3] to be 4.50 percent on the dry solids basis. Nitrogen has been reported as making up 15 to 19 percent of a protein[1] and so it can be assumed that proteins make up 23 to 30 percent of primary sewage sludge. Certainly with this percentage of protein-like material in sludge there is a possibility that there may be many of the proteins present.

Proteins are divided into three classes, as follows:

1. Simple proteins.
2. Conjugated proteins.
3. Derived proteins.

The simple proteins are those found in nature, that, when treated with acid or the proper enzyme, will break up into alpha-amino acids or their derivatives.

SOME organic sewage solids are removed in the screening process, but these are returned to the flow after grinding

Albumins such as the ovalbumin of egg white, serum albumin, and vegetable albumin (such as that from wheat) are simple proteins; they are soluble in water and dilute salt solutions and are coagulated by heat.

Globulins are simple proteins found in muscle and a great many seeds. These materials are insoluble in water.

Glutelins are found in wheat and rice and these simple proteins are readily soluble in very dilute acids and alkalies.

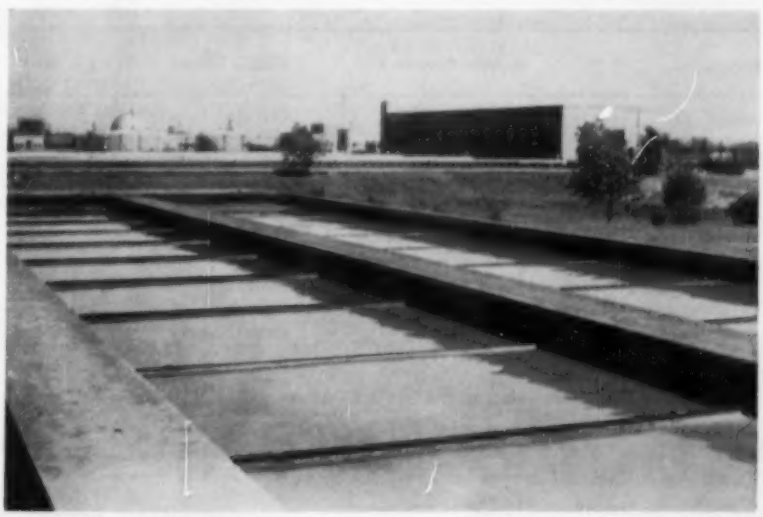
The *prolamines* are insoluble in water. In this group are zein from corn, gliadin from wheat, and hordlin from barley.

Albuminoids are insoluble, but they must exist in sewage solids because they are found in horn, hide, hoof, hair, feathers and ligaments. Gelatin is placed in this group, but it is soluble in water.

Histones are the globin from blood,

TABLE 2
Fatty Acids

1. Butyric, in butterfat
2. Caproic, in butter, coconut and palm nut oils
3. Caprylic, in butter, coconut and palm nut oils
4. Capric, in butter, coconut and palm nut oils
5. Palmitic, in animal and vegetable fats
6. Stearic, in animal and vegetable fats
7. Arachidic, in peanut oil
8. Cerotic, in beeswax and wool fat
9. 1,4,methyl palmitic, in wool fat
10. Myristoleic, in fish oil
11. Palmitoleic, in fish oil
12. Oleic, in animal and vegetable fats
13. Vaccenic, in butterfat
14. Gadoleic, in fish oils
15. Cetoleic, in fish oils
16. Linoleic, in linseed and cotton seed oils
17. Lanopalmic, in wool fat
18. Lanoceric, in wool fat



SETTLEABLE and floating solids are removed in the primary tanks for pumping to the digesters

SOME TYPES of sewage solids can cause such problems as this aerator frothing

the corpuscles of birds, and materials from the thymus gland. The histones are soluble in water, insoluble in very dilute ammonia, not coagulated by heat, and easily soluble in very dilute acids.

Protamines are found in ripe sperm cells, are soluble in water and ammonia, and form true salts with mineral acids.

Conjugated proteins are made up of simple proteins bound with some non-protein group.

Nucleoproteins are made up of one or more protein molecules with nucleic acid. These proteins are found in glandular tissue and yeast.

The *glycoproteins* are simple proteins attached to a carbohydrate. Tissues that produce mucus are particularly rich in glycoproteins. These are *phosphoproteins*, proteins that have phosphate attached to them.

The *chromoproteins* include the hemoglobin of animal blood and the cyanin of hemocyanin of some creatures of the sea. There are also *lecithoproteins* and *lipoproteins*.

Derived proteins are a group made up of the various decomposition products of naturally occurring proteins which have been acted upon by chemicals, enzymes or heat. Included in this group are *proteans, metaproteins, peptones,* and *peptides*.

It has been previously indicated that proteins are made up, in part at least, of amino acids. When bacteria and fungi decompose proteins, the proteins are hydrolyzed to their constituent amino acids. The microorganisms then act upon the amino acids and produce acids or bases.

The deamination of proteins is accomplished by either aerobes or anaerobes. The characteristic decomposition by the aerobes results in the production of a saturated acid with one less carbon than in the original amino acid or the production of a hydroxyl acid. Anaerobic decomposition of a protein may result in the release of ammonia and a saturated acid if reduction takes place. If reduction does not take place ammonia and an unsaturated acid results. The putrefying bacteria carry on decarboxylation and form amines and carbon dioxide.

The decomposition may, however, result in the formation of formic acid, in which case the amine that remains has one less carbon atom than the original amino acid. It is reported that some biochemists believe that both reactions take place, inasmuch as formic acid and carbon dioxide are both formed.

It is apparent from reading the literature that there is not a complete understanding of the processes of aerobic and anaerobic decomposition of proteins.

TABLE 3

Enzymes Known to Act on Substances Found in Sewage

Enzyme	Material Converted	Product Formed
Lipase	Fats and oils	Glycerol + fatty acid
Pectase	Pectin	Pectic acid + methyl alcohol
Tannase	Tannin	Glucose + digallic acid
Invertase	Sucrose	Glucose + fructose
Maltase	Maltose	Glucose
Lactase	Lactose	Glucose + galactose
α—Amylase	Soluble starch	Dextrin + maltose
β—Amylase	Soluble starch	Maltose
Cellulase	Cellulose	Cellobiose
Hemicellulase	Hemicellulose	Simple sugars
Rennin	Casein	Paracasein
Pepsin	Proteins	Peptones
Trypsin	Proteins	Polypeptides + amino acids
Cathepsin	Proteins	Polypeptides + amino acids
Ficin	Proteins	Polypeptides + amino acids
Papain	Proteins	Polypeptides + amino acids
Bromelin	Proteins	Polypeptides + amino acids
Urease	Urea	Ammonia + carbon dioxide

Fats

Fats constitute a third group of materials that are considered to make up the solids found in sewage. In the discussions on carbohydrates and proteins an attempt at a definite differentiation of each has been hoped for, but it has been quite impossible to say that a protein contains these elements and not others, or that a carbohydrate contains only certain elements.

So it is also with fats. Nonetheless, attempts have been made at classification of fats. Natural fats and oils have been placed in two groups, as follows:

1. Fatty or non-volatile oils.
2. Essential or volatile oils.

The first group is composed of esters (organic salts) of fatty acids. The second includes those materials

that will come off in steam distillation, but separate in the distillate.

The fatty acids combined with other substances in natural fats and oils are quite numerous, as can be seen by the listing in Table 2, which gives only those fats and oils that are to be found most often in sewage.

The sewage plant operator is well aware of the presence of fats and oils in sewage. The problems resulting from the presence of these materials are:

1. The difficulty in getting the floating oil or fat skimmed from the sewage.
2. The decomposition of the fats and oils in the biologic process.
3. The control of odors that are present when oils and fats accumulate on channel walls and other similar places.

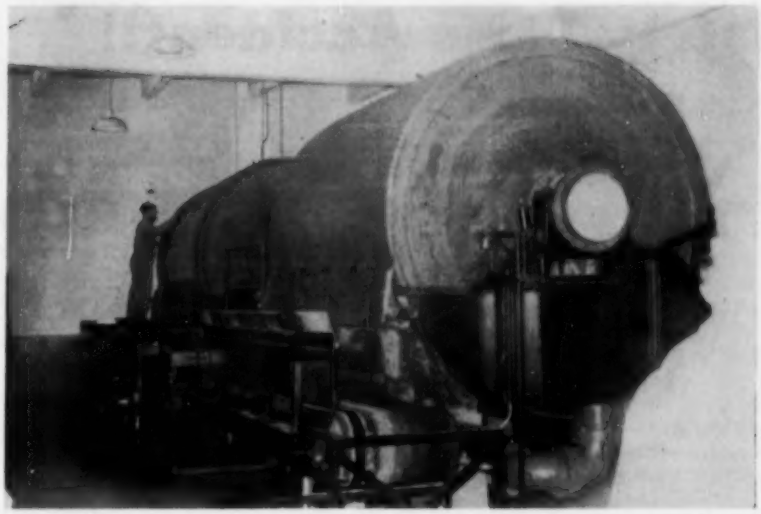
The so-called rancid odor noted in some sewage plants may be the result of the hydrolysis with the liberation of fatty acids or there may be an oxidation of the fats or oils with the liberation of aldehydes, ketones and acids with lower molecular weight than the acid originally present. Many of the fatty acids have characteristic odors that are noticeable and sometimes objectionable when released from the fats in which they have been combined.

It has been mentioned previously that the metabolism of animals and microorganisms is similar in some respects. There is apparently very little known about the decomposition of fats and oils by bacteria. It is known that these substances are used as food by some microorganisms.

In the digestion of fats and oils by humans there is reported to be very little digestion that takes place in the stomach. The fat is believed to be emulsified, by the bile salts, as it enters the small intestine. Thus prepared, the fats are more easily brought in contact with the lipase of the pancreatic juice, which is believed to be the major fat-digesting enzyme. The fats are hydrolyzed to the fatty acids and glycerol, in which form they can be absorbed through the intestinal wall.

Not all fats and oils digest at the same rate. There seems to be some relation between the melting point of the fat and the possible rate of digestion.

The absorbed fat, unlike the amino acids and the simple sugars, does not go directly into the blood stream from the wall of the intestine, but goes into the lymph circulation and then into the venous circulation. Therefore, it does not first pass through the liver, but short circuits it until the blood returns to the liver in the arteries.



PRIMARY or digested solids eventually must be disposed of after drying on beds or vacuum filters

It is true that the human body is a much more complex organism than a bacterial cell. Nonetheless, it seems reasonable that the fats and oils must undergo several changes outside of the cell before they can be utilized by the cell.

Enzymes

In the discussion of the decomposition of organic solids, mention has been made of the substances that aid in the conversion of organic materials into usable food for bacteria and animals.

Enzymes have been mentioned as aids to the digestion processes. The enzymes are described as catalysts, or substances that do not enter into the chemical changes but only aid in controlling the speed of the change.

The concentration of enzymes in sewage is probably very low. Therefore, as solids they are not to be considered as important solid material that must be disposed of by some means. However, in the disposal of sewage solids by biological means, enzymes, and many of them, become very important.

Certain of the enzymes are secreted by cells and are known as *extracellular* enzymes. There are others that are apparently a part of living cells and act within the cell walls. This type of enzyme is classed as an *intra-cellular* enzyme.

Enzymes are found wherever microorganisms are making changes in the material that is available to them as food. Table 3 gives a listing of only a few enzymes that act upon some of the solids that are found in sewage. It should be noted that the end products formed are not oxidized materials and so are not of an inert nature and are subject to decomposition by microorganisms.

In addition to the enzymes listed in Table 3, there are perhaps fifty or more enzymes known that are necessary in the breaking of the carbon chain in the compounds that have been acted upon by other enzymes.

It can be concluded that the suspended and dissolved solids in sewage originating from kitchens, industrial plants, bathrooms and laundries are complex materials that must undergo decomposition before ultimate disposal. The decomposition that takes place involves many biological transformations prior to the conversion to inert substances.

Acknowledgment

The writer is indebted to the Gortners, authors of "Outlines of Biochemistry[2]," for much of the information used in the preparation of this paper.

References

[1] Bloodgood, D. E., "Organic Solids in Sewage Treat," Water & Sewage Works, *100*, 6, 244 (June 1953).

[2] Gortner, "Outlines of Biochemistry," Third Edition, John Wiley & Sons.

[3] Babbitt, H. E., "Sewerage and Sewage Treatment," 7th Edition, page 471, John Wiley & Sons.

Safety Is No Accident!!

An open letter from one water works operator to another

Dear Bill.

While I was driving by an industrial plant recently, I saw a big sign painted on the gate; it read, "SAFETY IS NO ACCIDENT". That got me to thinking about safety practices. Do you remember when the only safety slogan was "Safety First" and then came the A B C of Safety: "Always Be Careful". The slogans have multiplied over the years, and they have served to draw the workers' attention to the need for safe practices. But it takes more than slogans to prevent accidents. It takes a good safety program.

Need for Safety Program

You know that for years I have been safety conscious and have felt that the water works industry needed some guidance in that matter. You must know, too, that I was happy to see the new "AWWA Manual on Safety Practice for Water Utilities" the first two parts of which were published in the July 1955 issue of the AWWA Journal.

As you know that manual is the result of several years study by the AWWA Committee A2.E, of which Ray Faust, Exec. Asst. Secy. of AWWA, is the chairman.

Perhaps, by now, you have read the first two parts (July Journal) and as much of Part 3 as has appeared in the August and September issues of the Journal. But if you are as busy as most superintendents, you may not have had time yet to look at any more than the title.

Just in case you haven't read the material published so far, I'd like to point out a few pertinent facts from the manual. Did you know, for example that the Water Works industry has a higher rate of frequency for accidents than gas, electrical or communications industries (in that order), and the severity rate is the second highest.

Frequency is, of course, the number of disabling accidents per million man hours and severity is the number of days lost per million man hours worked. From the water works that have been reporting to the National Safety Council, it appears that the frequency rate in water works is 23.19 (communications is 1.22) and the severity rate for water works is 930 (electrical, 1550; communications 100). Man, if these rates hold in all water works, then we certainly do need a safety program in this business.

The fact that most water works employ relatively few men doesn't help. The data show that utilities with less than 10 men have a frequency rate of 17.2 and a severity rate of 2700 (the highest).

Cause of Injuries

Handling objects causes more accidents than any other source. This is followed by falls, falling objects, machinery, tools, etc. You may not believe this but injuries to the body lead all the rest, followed by injuries to the fingers, arms, hands, feet, head, eyes and toes.

As to type of injuries, bruises, contusions, cuts, and lacerations lead all the rest, followed by sprains and strains, fractures, burns, and eye injuries.

Cost of Injuries

According to Faust's committee report, the cost of accidents mounts up for a host of reasons, and these are actual computable costs. The report lists 10 specific categories and a miscellaneous category containing at least 100 other specific items.

The benefits to be gained from safety practices are many; improved efficiency, improved service, increased earnings, better employee morale, better public relations. And, don't forget, that all those direct outlays for costs by both utility and individual are saved.

A Safety Program

I'd particularly like to call your attention to Part 2 of the Manual (published on p. 645 of the July AWWA Journal). In that section it tells not only how to start but also how to maintain a safety program. To prevent accidents just follow five simple common-sense steps set forth by the committee.

The first thing to do is to keep records of all injuries, source, cause, result, cost, time lost, etc. Next, make a habit of looking for hazards; you'll get so that as you walk through your plant you literally "feel" when you are in an area where unsafe conditions exist.

Your next step is to correct any unsafe condition no matter where it exists. The manual lists some 16 procedures to be carried out; things like providing good lighting and tools, removing obstacles and debris, etc., etc.

Next step in your program is to get your employees interested in SAFETY. This is an important factor in employee-management relations. Believe me, as soon as this Manual is available in separate form, in a few months, I'm going to get several copies. Then I'm going to mark one copy with marginal lines (using one, two or three lines to indicate relative importance) alongside paragraphs or parts that apply to our plant. Then I'll give the other copies to our safety committee to mark likewise and to pass to all our men.

The Manual says, and I know it's so right, "teaching employees good work habits" will show them how to do their job with less risk to themselves as well as improving efficiency. That's why I have our supervisory men make a special study of safety practices and meet regularly with the safety committee.

Safe Working Practices

In Part 3 of the Manual there are 23 sections dealing with every possible operation or function in a water works. And Part 4 will contain a full list of references to sources of safety information.

You'll have to forgive me for raving about this Manual. I know you can read it yourself but I was so impressed with some of its material that I couldn't help quoting from it, along with some comments of my own. I think this Manual is so good that I'm going to give a copy to our sewage works superintendent and suggest that he send it to the Federation of Sewage and Industrial Wastes Assns. They must need a safety manual, too.

Yours. Jim

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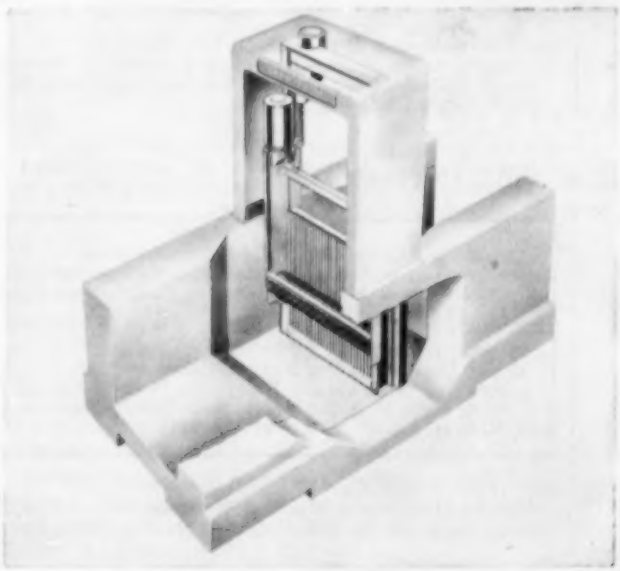

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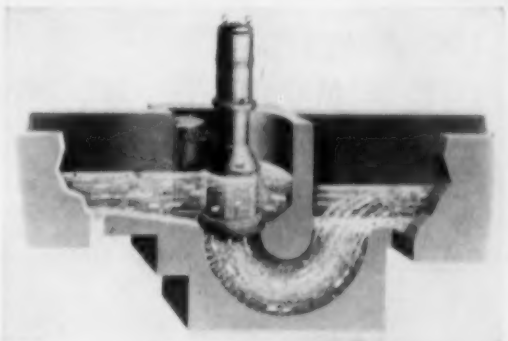

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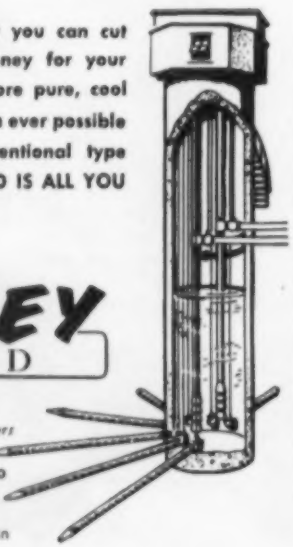

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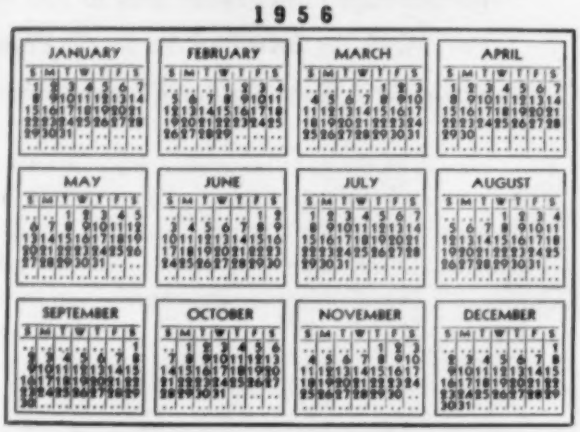

Oct. 3-7—State College, Pa. *(State College)*
WATER WORKS SCHOOL, R. R. Kountz, Ass't Prof. San. Engr., State College, Pa.

Oct. 4-5—Springfield, Ill. *(Leland Hotel)*
ILLINOIS WATER PLANT OPERATORS CONFERENCE, ANNUAL MEETING. Clarence W. Klassen, Chief San. Engr., State Dept. Public Health, Springfield, Ill.,

Oct. 5-7—Minneapolis, Minn. *(Radisson Hotel)*
NORTH CENTRAL SECTION A.W.W.A., Secy. Leonard N. Thompson, Gen. Mgr., Water Dept., St. Paul 2, Minn.

Oct. 10-13—Atlantic City, N. J. *(Ambassador Hotel)*
FEDERATION OF SEWAGE & INDUSTRIAL WASTES ASSOCIATION. (Annual Meeting). Sec'y, R. E. Fuhrman, 4435 Wisconsin Ave., N.W., Washington 16, D. C.

(joint meeting with)

Oct. 10-13—Atlantic City, N. J. *(Ambassador Hotel)*
NEW JERSEY SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, M. S. Kachorsky, P. O. Box 766, Manville, N. J.

Oct. 11-14—Atlantic City, N. J., *(Chalfont Hotel)*
PENNSYLVANIA WATER WORKS ASSOCIATION (Annual Meeting) Sec'y, Davis Dunlap, 2609 N. Second St., Harrisburg, Pa.

Oct. 12—Norridgewock, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Oct. 16-19—San Antonio, Tex. *(Gunter Hotel)*
SOUTHWEST SECTION A.W.W.A. Sec'y, Leslie A. Jackson, Robinson Memorial Auditorium, Little Rock, Ark.

Oct. 17-18—Sydney, Nova Scotia *(Isle Royale Hotel)*
MARITIME BRANCH, CANADIAN SECTION A.W.W.A., J. Douglas

(Continued on page 100A)

Standby...for Action

... the dependability built into Le Roi engines means that you have power when you need it most

The operator of the Le Roi F1500 shown above said, "This engine has surpassed our every requirement for standby power, and has more than paid for itself with dependable, economical, power production when we needed it most."

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For example, Le Roi engines are so compact that you save on installation costs. Volume production and post-war designs give you more horsepower per dollar. Also, because Le Roi engines can use the lowest cost fuels available, savings in operating costs are important, too. We have some engines that have saved taxpayers over $4000 a year for 14 years — others that have saved $7600 in a 10-month period. And so it goes.

You, too, can save your taxpayers' money and still provide them with the services they need, by using Le Roi engines. Sizes range up to 645 hp, or in custom generator sets from 50 to 350 KW. And all Le Roi's operate on natural gas, LPG, gasoline, or no-cost sewage gas. Write us for our latest literature.

E-155

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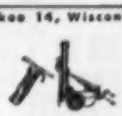
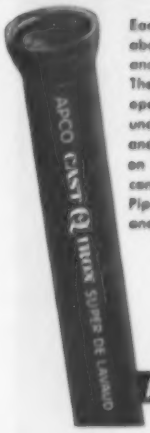

AIR TOOLS

ENGINES



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Kline, P. Eng. Chief Engineer, Public Service Commission, P. O. Box 608, Halifax, N. S.

Oct. 17-19—Pittsburgh, Pa., *(Hotel William Penn)*
16th ANNUAL WATER CONFERENCE, W. M. Porter, Sec'y., The Engineers Society of Western Pensylvania, Hotel William Penn, Pittsburgh 30, Pa.

Oct. 19-20—Clarksburg, W. Vir. *(Waldo Hotel)*
WEST VIRGINIA SEWAGE & INDUSTRIAL WASTES ASSOCIATION (9th Annual Meeting) Sec'y, G. O. Fortney, State Dept. of Health, Charleston 5, W. Va.

Oct. 19-21—Des Moines, Ia. *(Hotel Fort Des Moines)*
IOWA SECTION A.W.W.A. Sec'y, H. V. Pedersen, Municipal Bldg., Marshalltown, Ia.

Oct. 20-21—Clarksburg, W. Va. *(Waldo Hotel)*
WEST VIRGINIA SECTION A.W.W.A. Sec'y, Harry K. Gidley, State Dept. of Health, Charleston, W. Va.

Oct. 20-22—Atlantic City, N. J. *(Madison Hotel)*
NEW JERSEY SECTION A.W.W.A. (Fall Meeting). Sec'y, C. B. Tygert, Box 178, Newark, N. J.

Oct. 24-28—New York, N. Y. *(Hotel Statler)*
AMERICAN SOCIETY OF CIVIL ENGINEERS. (Annual Meeting). Sec'y, Wm. H. Wisely, 33 West 39th St., New York, N. Y.

Oct. 24-28—State College, Pa. *(State College)*
SEWAGE WORKS SCHOOL, R. R. Kountz, Ass't Prof. San. Engr., State College, Pa.

Nov. 14-18—Kansas City, Mo. *(Municipal Auditorium)*
AMERICAN PUBLIC HEALTH ASSOCIATION (83rd Annual Meeting). Exec.-Sec'y, Dr. Reginald M. Atwater, 1790 Broadway, New York, N. Y.

Nov. 16-18—Allerton Park, Ill. *(Univ. of Illinois)*
WATER WORKS MANAGEMENT SHORT COURSE, Director Dr. T. E. Larson, State Water Survey, Urbana, Ill.

Nov. 21-22—Kansas City, Mo. *(Continental Hotel)*
KANSAS CITY HYDRAULICS CONFERENCE, Kansas City Section A.S.C.E., Glenn C. Gray, Publicity Chairman, 19 East Gregory Blvd., Kansas City 14, Mo.

Nov. 27-30—Cleveland, Ohio
NATIONAL CHEMICAL EXPOSITION, at Public Auditorium, Cleveland, Ohio, sponsored by Chicago & Cleveland Sections, American Chemical Society.

Dec. 11-17—Cleveland, Ohio
NUCLEAR ENGINEERING & SCIENCE CONGRESS, Cleveland, Ohio, sponsored by Engineers Joint Council.

Dec. 14—Augusta, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

1956

Feb. 8-10—Indianapolis, Indiana *(Lincoln Hotel)*
INDIANA SECTION, A.W.W.A., Secy., Robert J. Becker, Indianapolis Water Company, 113 Monument Circle, Indianapolis 6, Ind.

Feb. 13-17—Dallas, Texas
AMERICAN SOCIETY CIVIL ENGINEERS

Mar. 21-23—Chicago, Illinois *(LaSalle Hotel)*
ILLINOIS SECTION, A.W.W.A., Secy., Dewey W. Johnson, Cast Iron Pipe Research Association, 122 So. Michigan Ave., Chicago 3, Ill.

Mar. 18-21—Augusta, Georgia *(Bon Air Hotel)*
SOUTHEASTERN SECTION, A.W.W.A., Secy., N. M. deJarnette, Engr., State Dept. Pub. Health, 245 State Office Bldg., Atlanta 3, Ga.

Apr. 4-6—Topeka, Kansas *(Jayhawk Hotel)*
KANSAS SECTION, A.W.W.A., Secy., Harry W. Badley, 119 W. Cloud, Salina, Kansas.

Apr. 5-6—Chapel Hill, N. C.
FIFTH SOUTHERN MUNICIPAL & IND. WASTE CONF., Daniel A. Okun, Univ. of North Carolina, Chapel Hill, N. C.

Apr. 5-7—Safford, Arizona *(Hotel not selected)*
ARIZONA SECTION, A.W.W.A., Secy., Quentin M. Mees, Ariz. Sewage & Water Works Assn., 721 N. Olson Ave., Tucson, Ariz.

Apr. 6-7—Livingston, Montana *(Lincoln Hotel)*
MONTANA SECTION, A.W.W.A., Secy., A. W. Clarkson, State Board of Health, Helena, Montana.

Apr. 11-13—Nebraska *(Hotel and City not selected)*
NEBRASKA SECTION, A.W.W.A., Secy., John E. Olsson, 922 Trust Bldg., Lincoln, Nebr.

Apr. 18-20—Utica, New York *(Hotel Utica)*
NEW YORK SECTION, A.W.W.A., Secy., Kimball Blanchard, 56 Grand St., White Plains, N. Y.

Apr. 23-25—London, Ontario *(Hotel London)*
CANADIAN SECTION, A.W.W.A., Secy., A. E. Berry, 72 Grenville St., Toronto, Ont., Canada.

Apr. 26-28—Victoria, B. C. *(Canada Empress Hotel)*
PACIFIC NORTHWEST SECTION, A.W.W.A., Secy., Fred D. Jones Distr. Supervisor, Rm. 305, City Hall, Spokane, Wash.

May 6-11—St. Louis, Mo. *(Hotel not selected)*
A.W.W.A. CONVENTION, Secy., Harry E. Jordan, A.W.W.A. Assn., 521 Fifth Ave., New York 17, N. Y.

June 4-8—Knoxville, Tenn. *(Hotel not selected)*
AMERICAN SOCIETY CIVIL ENGINEERS

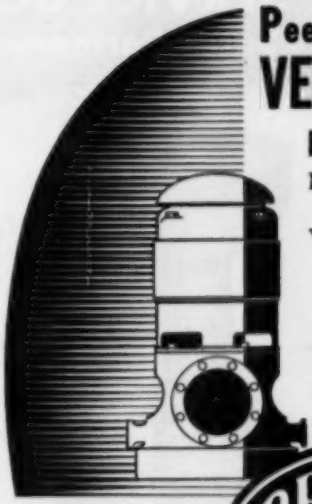
Sep. 12-14—Bolton Landing, Lake George, New York *(Sagamore Inn)*
NEW YORK SECTION, A.W.W.A., Secy., Kimball Blanchard, 56 Grand St., White Plains, N. Y.

Sept. 12-14—Flint, Michigan *(Durant Hotel)*
MICHIGAN SECTION, A.W.W.A., Secy., T. L. Vander Velde, Mich. Dept. of Health, Lansing 4, Mich.

Sept. 16-20—NEW ENGLAND WATER WORKS ASSN., Secy., Geo. C. Bogren, 14 Beacon St., Boston 8, Mass.

Sept. 17-19—Chattanooga, Tenn. *(Hotel Patten)*
KENTUCKY-TENN. SECTION, A.W.W.A., Secy., J. Wiley Finney, Jr., Tenn. Dept. of Pub. Health, 420 6th Ave. N, Nashville 3, Tenn.

Sept. 19-21—Toledo, Ohio *(Commodore Perry Hotel)*
OHIO SECTION, A.W.W.A., Secy., M. E. Druley, Dist. Mgr., Dayton Power & Light Co., Wilmington, Ohio.



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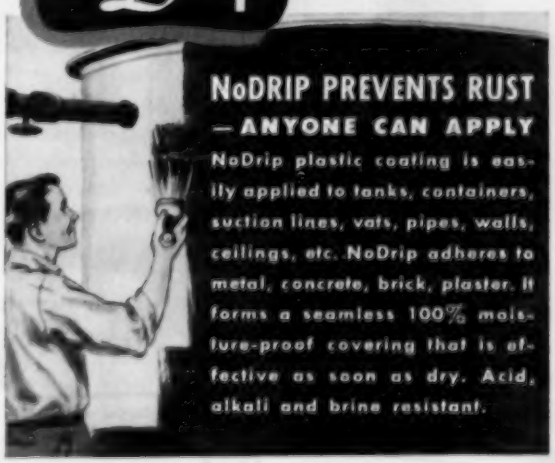
NoDrip ...STOPS CONDENSATION DRIP



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SPILLWAY

Willard Schade Continues MacDowell Engineering Firm

Willard F. Schade, former associate of the late Rollin F. MacDowell in the consulting firm of Rollin F. MacDowell and Associates, Cleveland, Ohio, has organized Willard F. Schade & Associates as successors to the MacDowell firm.

Mr. Schade holds a M.S. degree in Chemical Engineering from Case Inst. of Technology and holds Class A licenses as Water and Sewage Works operator in Ohio in addition to his registration as Professional Chemical Engineer. He began his sanitary engineering career as senior Chemist-Bacteriologist at Cleveland's new Easterly Sewage Treatment Plant. Thereafter he became associated with Havens & Emerson Engrs. of Cleveland. During World War II he was captain in the U. S. Army Sanitary Corps and after the war as Public Health Officer and Utilities Officer and Sanitary Engineer in the European Military Government. In 1946 he returned to the U. S. to become Associate Engr. with Rollin F. MacDowell and Associates.

Mr. Schade is a member of a number of professional societies and the fraternities Tau Beta Pi, Alpha Chi Sigma and Kappa Sigma. Offices of the new firm are in the Chester-Twelveth Bldg., Cleveland, Ohio.

Shea Elected Chairman of New England Commission

At the recent Annual Meeting of the New England Interstate Water Pollution Control Commission at Whitefield, N. H., Walter J. Shea, Chief Sanitary Engineer of the Rhode Island Department of Health, was elected Chairman of the Commission. During the past year Mr. Shea served as Vice-Chairman of the Commission. He succeeds Roger L. Putnam of Springfield, Mass., as Chairman.

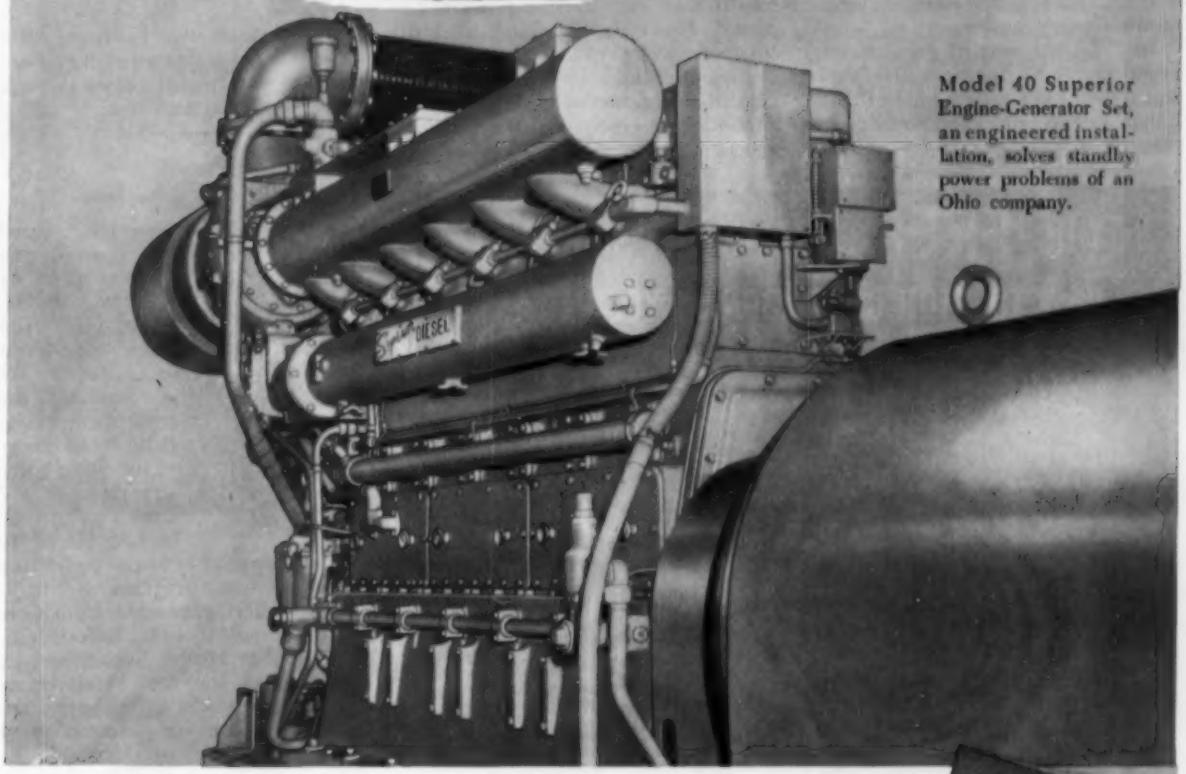
The new Vice-Chairman of the Commission is William S. Wise, Di-

(Continued on page 104A)

see how

Superior or Atlas Engines

solve your **standby power** problems



Model 40 Superior Engine-Generator Set, an engineered installation, solves standby power problems of an Ohio company.

Engineered installations of Superior and Atlas Diesel, dual fuel and gas engine-generator sets have solved hundreds of standby power problems! In many cases they've paid for themselves. Their automatic start and stop operation often averts tragic consequences, by providing efficient, dependable power for essential plant services in every instance of main power source failures. In order for you to have all the facts and figures we've prepared a special case history file. It shows many instances of how our skilled engineers assisted in solving serious problems involving special considerations and peculiarities in individual installations. Chances are many of the installations will be similar to yours. This information will prove a valuable aid in your planning.

Write, on your letterhead, requesting this file of helpful examples. White's skilled engineers, with years of experience in developing engineered installations of Superior or Atlas engine-generator sets, will assist you in engineering the proper standby power for your specific requirements.

WHITE DIESEL ENGINE DIVISION

THE WHITE MOTOR COMPANY • ***Plant and General Offices: Springfield, Ohio***

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rector of the Connecticut State Water Commission. John F. Casey of Massachusetts was re-elected Treasurer.

Water For Steel Production Treated and Recirculated

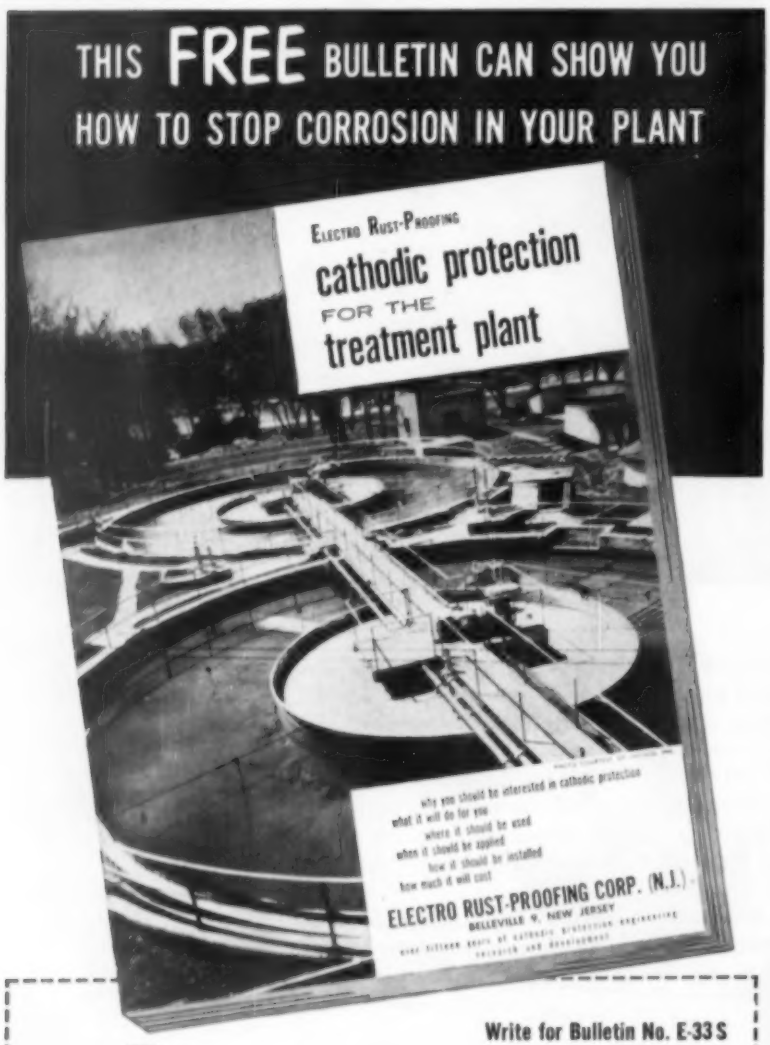
The steel industry requires water at the rate of nearly six million gallons every minute, according to the American Iron and Steel Institute. The figure is based on a recent Bureau of the Census survey.

In 1953, the year of greatest steel production, blast furnaces, steelworks and rolling mills used a total of 3,108 billion gallons. However, about 55 per cent of that water was recirculated back into surface water sources, often in a purer condition than when it was received.

Blast furnaces accounted for about one-third of the water used by the steel industry, excluding coke plants. More than 57 tons of water (13,757 gallons) was used per ton of pig iron produced in 1953. By comparison, less than 3.2 tons of solid raw materials was charged into blast furnaces per ton of iron output during the same period. However, the water used in blast furnace operations is mostly for cooling purposes, and about 80 per cent of it is returned to its source in a continuous recirculating system. Steelworks and rolling mills recirculated 42 per cent of the water they used in 1953.

More than 90 per cent of blast furnace and 80 per cent of steelworks and rolling mill water requirements were taken from streams, rivers, lakes and other surface water sources. Less than five per cent of total water usage came from ground sources such as wells and springs. The small remainder was obtained from public water systems.

According to the Institute, steel companies have sponsored many advances in water conservation through wastes treatment and re-use.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treatment plant
why you should be interested in cathodic protection
what it will do for you
where it should be used
when it should be applied
how it should be installed
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E-33

J. R. Hoffert Passes

Pennsylvania Stream Cleanup Pioneer

John R. Hoffert, recently retired Chief Engineer of the Pennsylvania Department of Health, Harrisburg, Pa., died June 4 after a short illness. He had been with the department since 1919. As an officer of the State Sanitary Water Board from 1927 to 1946 he had helped to launch Pennsylvania's pioneering "Clean Streams" program.

Mr. Hoffert graduated from Cornell University in 1911. Before joining the State Health Department he had worked for the Pennsylvania Steel Company, the Harrisburg Park Commission, and on construction of Edgewood Arsenal in Maryland.

He was a member of the Pennsylvania Sewage and Industrial Wastes Association and the American Society of Civil Engineers.

Important Step Reported in Fluoridation Research

An important step in the study of the effects of fluoridated water has been taken through research recently completed by Dr. Harold C. Hodge, Head, Department of Pharmacology and Toxicology at Strong Memorial Hospital, and Consultant in Dental Research; Dr. Isaac Feldman, Assistant Professor of Physical Chemistry; and Dr. Donald E. Morken, Junior Scientist, Atomic Energy Project, all of the University of Rochester. Their findings were revealed at an annual meeting of the American Societies for Experimental Biology.

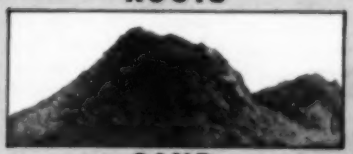
Tests revealed that the fluosilicate that is put into water by cities to prevent tooth decay breaks down into

(Continued on page 106A)

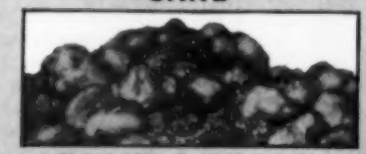
WANTED!

Tough Sewer Stoppages

ROOTS



SAND



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Flexible wants tough assignments, like these, to prove what the equipment can do. The majority of cities use "Flexibles" today because they *"saw them in action"*—learning first hand how they drastically reduce cleaning costs.

Check performance with the "Flexible" user near you. But, when you see a "demonstration," be sure it's a difficult job that really puts the equipment to test.

REMEMBER, DEMONSTRATIONS IN CLEAN SEWERS PROVE NOTHING!

Learn what "Flexibles" can do for your city. Send for Catalog 55-A or write to arrange a demonstration.

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Scientifically designed, the Smith & Loveless Sewage Ejector answers the need for trouble-free operation.

Our research has developed a sewage ejector with these features:

No stuffing box to leak or bind
No electrodes to foul or spark
Visual indication of sewage level
Corrosion-resistant lining inside receiver
No sewage in contact with level control

Also available in simplex or duplex Smith & Loveless Factory-Built sewage lift stations similar to pump station shown below.

SMITH & LOVELESS, INC. • P. O. Box 8172, Dept. W5, Kansas City, Mo., Plant, Merriam, Kansas

fluoride almost immediately, so that a person drinking the water ingests pure fluoride, rather than the compound fluosilicate.

This is important to researchers because a large body of knowledge, amounting to about 5,000 scientific reports, exists on the effects of fluoride on living tissue, whereas there is little information on the effects of fluosilicate. The new work, according to Dr. Hodge, "shows that all we know about fluorides, guaranteeing the safety of using them, is valid—can be applied to water into which fluosilicate has been mixed."

Pennsylvania Reports on Fluoridation Status

The latest compilations of the Bureau of Sanitary Engineering of the Pennsylvania State Department of Health show that 30 percent of the total population of that state is now using fluoridated water. This is pointed to by Health Department officials as wide acceptance by the public in that state over a comparatively few years of the fluoridation process as a means of protecting the teeth of children against caries. The first fluoridation permit in the state was issued by the Health Department to Ford City on February 14, 1951.

The data show that there are 25 fluoridation installations in 16 different water departments throughout Pennsylvania and that those departments serve 54 municipalities. It is further shown that fluorine treated water is now being served to 36 percent of that portion of the state's population which receives its water from public supplies.

All public water supplies are under the jurisdiction of the Bureau of Sanitary Engineering of the State Health Department and fluoridation may not be used without a permit from that department.

It is also necessary for the operation of a public water supply to have a Department permit, which is issued only after the Sanitary Engineering Bureau approves the plans covering the source of supply, equipment, water lines and other factors. Reports of daily operations must be submitted to the Bureau.

T. A. Berrigan Opens Consulting Office

Thomas A. Berrigan, until recently Director and Chief Engineer of the Sewage Division, Boston Metropolitan District Commission, has retired to open an office for the practice of law and engineering. He will continue as Chairman of the Merrimack Valley Sewerage Board, on which he has served for several years. Prior to his connection with the Metropolitan District Commission he had been Senior Engineer with the Boston Transit Department. His office will be located at 20 Providence St., Boston, Mass.

Pickups from Purdue's Sanitary Engineering News

Don E. Bloodgood, Editor

A 38-mile steel pipe line laid above ground with an inner coating of ½ inch of cement mortar delivers water to Adelaide, Australia.

* * *

Trees are not popular at sewage works in England because falling leaves interfere with the performance of trickling filters.

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Our new policy of centralized engineering in combination with qualified local licensee contractors inaugurates a new era in successful tank construction. Most of these licensees also employ former Preload superintendents, insuring reliable performance and superior jobs.

2-million gallon prestressed concrete tank on 83' tower at Dallas.

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- Experience all the way, from design to construction, by local licensed contractors.

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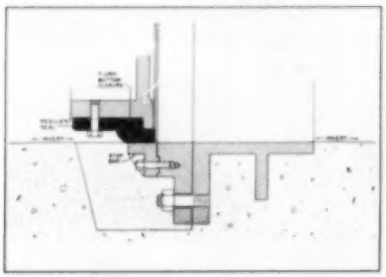
W&SW

New Equipment

Bottom-Seating Sluice Gate



1001

Rodney Hunt Machine Co., Orange, Mass., has developed the HY-Q Flush Bottom Closure sluice gate, which allows more flow yet insures closure against flow in either direction.

In the new gate, the frame has been lowered so that the opening is flush with adjacent chamber floors or with the natural bottom floorline. The gate seats flush with the invert. It eliminates the barrier which must be built for many gates to seat against or the deep pocket in which wedges must descend.

Like most sluice gates, the Rodney Hunt gate is of cast iron bronze-mounted construction. It is secured in its closed position by heavy bronze wedges on top and sides only which hold it tight against the frame. The patented HY-Q gate carries on the bottom of the gate disc a heavy strip of flexible Neoprene. When the gate is closed, the Neoprene flexes and gives a "cushion closing" seal which compresses on the stop bar.

Because of the greater head and improved flow characteristics of the new gate, a smaller gate size, narrower channel and lower channel walls will sometimes serve for a given volume of flow.

Fiberglass Reinforced Pipe

1002

Reinforced Laminates, Inc., Minneapolis, Minn., has developed a new line of fiberglass reinforced plastic pipe that is intended for use under corrosive conditions.

The thermosetting resins which are used give excellent resistance to most acid and alkaline solutions. In addition, this new pipe can be built for service where moderately high pressures and temperatures are encountered.

The pipe is currently available in sizes from 1¾ to 12 inches, inside diameter. According to the company, manufacturing methods are such that almost any diameter and wall thickness up to 36 inches diameter could be supplied on a custom-built basis without excessive tooling costs.

Diesel Electric Sets

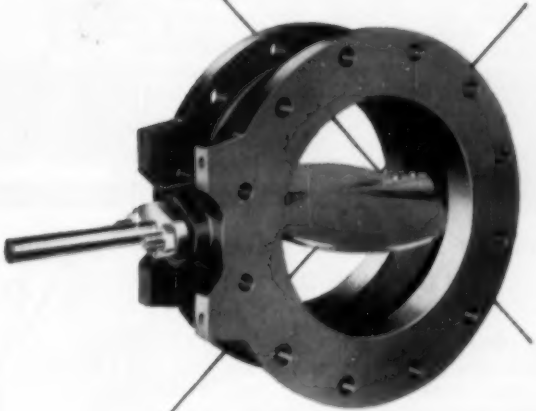
1003

Caterpillar Tractor Co., Peoria, Ill.,

(Continued on page 108A)

Blue Chip

For water works service...specify AWWA standard butterfly valves...



...by Builders-Providence

350 Harris Ave.,
Providence 1, R. I.

BUILDERS-PROVIDENCE

DIVISION OF B-I-F INDUSTRIES, INC.

BUILDERS IRON FOUNDRY • PROPORTIONEERS, INC. • OMEGA MACHINE CO.

METERS FEEDERS CONTROLS

has just developed a completely new line of diesel electric sets.

Combining the latest developments in design, materials and construction, the new self-regulated generator sets have the same desirable characteristics of externally-regulated sets and also maintains the simplicity of operation and motor starting ability of former model self-regulated units.

During initial installation of these new units, the "terminal" voltage and voltage "droop" can be adjusted to meet the special conditions of the particular application. After that, the adjustments are locked and no further adjustments are necessary. The units can be easily paralleled with most generators of any type or make now in use.

Stationary Compressors

1004

The Le Roi Division of Westinghouse Air Brake Co., Milwaukee, Wis., has developed a new line of two-stage, air-cooled, electric motor driven compressors. These new 50, 75, and 100 hp stationary compressors have displacements of 260, 415, and 550 cfm at 125 psi operating pressure.

Ideal for applications where compactness, light weight and a minimum of operator attention are required, the new compressors have a balanced design which reduces vibration and noise to a minimum. This prevents wear of both compressor and motor and lessens operating noise, a benefit to personnel working near the compressor.

Portable Field Laboratory For Bacteria Analysis of Water

1005

Salem-Brosius, Inc., Hyla Division, Pittsburgh, Pa., has just developed the new SABRO portable laboratory for quantitative bacteria analysis of water.

The laboratory, designed especially for field use, makes possible the complete analysis in about 18 hours, instead of the 2 to 4 days required for conventional testing procedures.

Slightly larger than a portable typewriter case, the kit contains all equipment essential to the test that would not be normally available in the field.

The Sabro test employs the membrane filter technique, wherein a quantity of water is passed through a circular membrane filter. Bacteria are retained on the surface of the membrane and, after addition of a nutrient media and proper incubation, a visible count of the original number of coliform bacteria is possible. Filters can be treated to provide permanent records.

Technicians to perform the analysis can be trained quickly, and normal sanitation measures are sufficient for accurate and reliable test data.

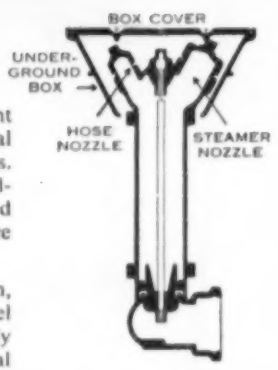
Redesigned B.O.D. Incubator

1006

Precision Scientific Company, Chicago, Ill., has redesigned their B.O.D. Incubator, now known as the "Dual Range" Low Temperature Cabinet. Primary among its new features is

(Continued on page 110A)

IT SETS COMPLETELY UNDERGROUND



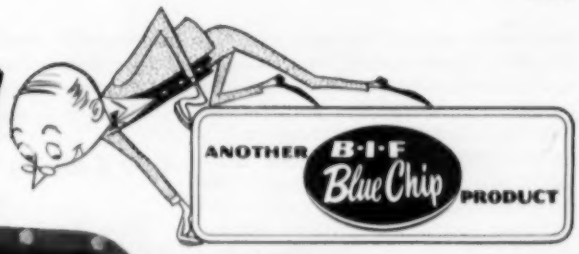
Where above-ground (Post Type) hydrants might interfere with traffic or operations in industrial plant areas, install M&H Flush Type Hydrants. They are equally suited for use around plant buildings, terminals, or airfields. They are widely used at airports where non-interference with surface traffic is a necessity.

The cast iron box, housing the nozzle section, sets flush with the ground level. The two-piece steel box cover is extra heavy and strong, is quickly lifted when access to the hydrant is desired. Internal construction of the hydrant is exactly the same as standard M&H fire hydrants, widely used by municipalities throughout the United States. For complete details, wire or write

M & H VALVE AND FITTINGS COMPANY, ANNISTON, ALABAMA

M&H PRODUCTS FOR WATER WORKS • FILTER PLANTS INDUSTRY • SEWAGE DISPOSAL AND FIRE PROTECTION

What a Meter for Water!



BUILDERS PROPELOFLO is an inexpensive main line meter for totalizing water consumption. Gives dependable, trouble-free service on the job. Meters accurately over wide range — six-digit totalizer shows water use directly in gallons, cubic feet, etc. For complete information on this easy-to-install meter, write to Builders-Providence, Inc., 350 Harris Ave., Providence 1, Rhode Island.

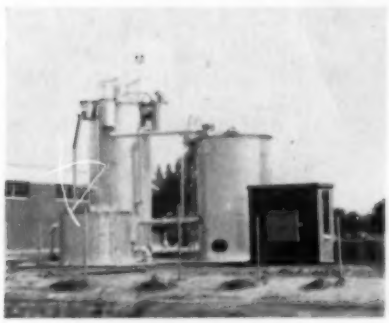
BUILDERS-PROVIDENCE

DIVISION OF B-I-F INDUSTRIES, INC.

BUILDERS IRON FOUNDRY • PROPORTIONEERS, INC. • OMEGA MACHINE CO.

B·I·F METERS FEEDERS CONTROLS

AN ALL STEEL Waste Treatment Plant



The tank at the left is a Spiragester, the tank to the right is a high rate filter, and the short tank in the foreground is a non-mechanized hoppered bottom final Spiraflo Clarifier. The plant handles the wastes from an ice cream manufacturing plant.

Write for New
Spiragester Bulletin No. 135

LAKESIDE ENGINEERING CORPORATION
222 West Adams Street • Chicago 6, Ill.

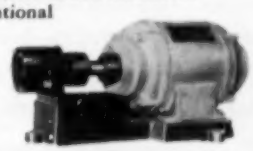
ACE-JABSCO ACID PUMP

OUT-LASTS OUT-PUMPS

anything in its price class

This little Jabsco, neoprene-impeller, self priming pump made of Ace hard rubber for handling acids and alkalis, delivers more liquid within its pressure range than any other pump in its weight, size and price class. From 15 gpm at 22 ft. head to 5 gpm at 72 ft. head. Self lubricated flexible impeller outlasts conventional metal rotors. Easy to service.

Ace hard rubber centrifugal and gear pumps also available. Write today for free Bulletin 97-A.



ACE rubber and plastic processing equipment • SINCE 1852

AMERICAN HARD RUBBER COMPANY, 93 Worth St., New York 13, N. Y.

the unique control system whereby the heater and cooling system cycle against each other at near-room temperatures, provide the new cabinet with two temperature ranges—a low range from 5° above freezing to 5° above room, and a high range from 5° above room to 50°C.

Other important features of the cabinet are external controls—reducing upset thermal conditions; 0.5°C temperature uniformity, even at near room temperature; adequate space for storing 150 small B.O.D. bottles. A motor-driven blower aids temperature uniformity by providing constant air circulation.

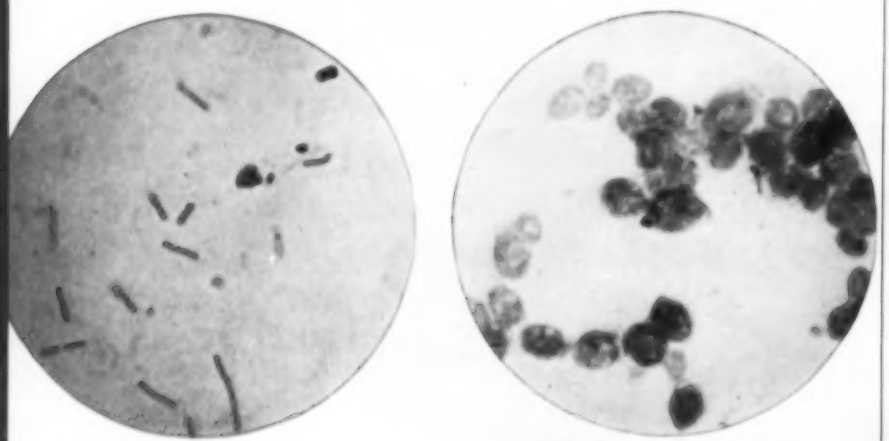
Cold Caulking Compound

1007

New England Carbide Tool Co., Inc., Cambridge, Mass., has introduced the new Philplug Cold Caulking Compound that is said to save time and money in all caulking operations, such as water mains, soil pipes, concrete or cast iron segments, etc.

Philplug caulking compound comes in two forms—either a loose fibre or in handy braided form. It withstands high temperatures and is unaffected by changes in temperature; has high resistance to acids and prevents bacteria growth. It has been tested and approved to withstand hydraulic pressure exceeding 1,000 psi; has been tested against deflection, expansion and contraction by hot water, and vibration.

A Technique for **Direct Staining**
with the **MF® MILLIPORE FILTER**
using a Modified Dye Mixture



Bacillus subtilis var. globigi — *Saccharonyces cerevisiae*

Direct staining after collection on the **MF** *from a suspension*

A dye technique for *direct staining* on the MF® MILLIPORE FILTER has been developed in the laboratories of the Millipore Filter Corporation. This dye will stain Staphylococcus, Streptococcus, Coliforms, Yeasts, Pseudomonas, B. subtilis (vegetative forms), Proteus, Molds, Diatoms, and Algae.

Mold spores stain well.

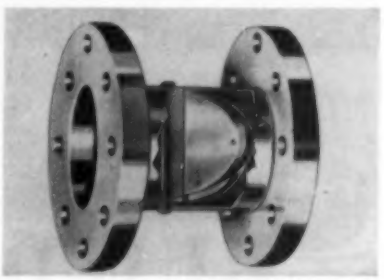
The microorganisms appear dark against a very light background.

For further information, write to the laboratories of the

MILLIPORE FILTER CORPORATION

36 Pleasant Street, Watertown 72, Mass.

New Type Check Valve



1008

Techno Corp., Erie, Pa., has developed the Technocheck, a uniquely constructed check valve that is said to perform with unusual efficiency and economy and to have a longer life than similar devices.

The valve works with maximum efficiency in high or low pressure water, gas, vapor, and other fluid lines giving positive automatic opening and closing on low pressure differential.

Technocheck has a simple, exclusive design that does not use a valve seat. It employs the body of the valve for that purpose. It permits unrestricted straight-line flow and is silent.

With discharge from pump, compressor, etc., the valve elements assume streamlined position and allow free flow. When flow reverses, valve elements instantly expand against valve wall, effecting a perfect seal against reverse flow. Smooth, "hammerless" action is due to hinge-type construction of elements and accurate machining of parts.

The valves are available in a range of sizes up to 36 inches.

Jet Pump Motors

1009

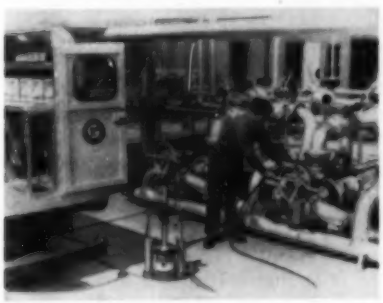
The Electric Motor Division of the A. O. Smith Corp., Dayton, Ohio, is now manufacturing a new line of fractional horsepower jet pump motors which features a number of improvements, includ-

ing a totally enclosed canopy housing that protects the vital parts from dirt, insects or rodents.

With the addition of vent slots to the main frame of the motor, the unit now also has a new, controlled ventilating system. Airflow is aimed at the coils; ball bearings are now practically out of the air stream, with the result that contamination of bearings by airborne grit is minimized.

In a functional grouping of components, the motor switch, starting capacitor and automatic overload protector all are conveniently end-mounted and protected by the enclosed canopy.

Self-Priming Valve Lubricant Gun



1010

Rockwell Manufacturing Company, Pittsburgh, Pa., has developed a new, compact, lightweight air-operated lubricating gun designed to meet field and plant maintenance needs.

Described as the only positive self-priming plug valve lubricant gun on the market today, the new "Hypregun" weighs only 39 pounds and operates on air pressures up to 150 psi.

A specially designed air motor and double piston construction provide the self-priming action, a feature of the new gun.

The "Hypregun" uses Rockwell-Nordstrom five-quart lubricant cans which are loaded directly into the gun, eliminating all manual handling of lubricant or changing lubricant from one container to another.

Gear Selector For Metering Devices

1011

Selective Industries, Inc., San Francisco, Calif., has announced the development of the Goldman Change Gear Selector that takes all the guesswork out of determining the correct size of the register and spindle gears for any metering device.

Developed and patented by Oscar G. Goldman of the San Francisco Water Department, the selector is said to eliminate mistakes, to work easily, and rapidly.

Improved pH Glass Electrodes

1012

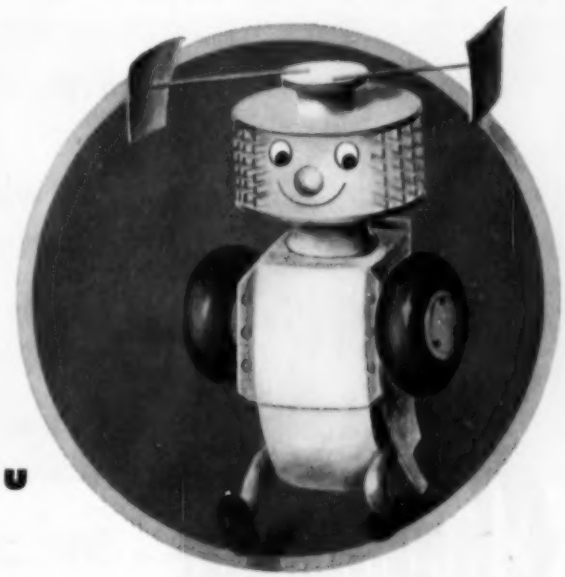
Beckman Instruments, Inc., Fullerton, California, has developed a new type of pH-sensitive glass which will benefit both laboratory and process control users of pH equipment.

Known as E-2 glass, the new formula, which represents considerable research and development work, is especially suited for high pH measurements. Type E-2 glass replaces Type E glass in the original and widely-used Beckman blue-tipped, alkali-resistant electrodes.

Electrodes with the new formula glass are extremely valuable in the range above pH 10 where other electrodes fail to perform satisfac-

(Continued on page 112A)

have you met



Mr. Centriline . . .

If not, you should! He can do things for you . . . like making your job easier and saving you money. He's a versatile and somewhat ingenious many-armed creature who specializes in cement-mortar lining the inside of pipes. And he's done this to over 4 million feet of pipe, too—eliminating corrosion and tuberculation . . . increasing flow capacity . . . reducing leakage . . . slashing pumping costs . . . and adding years and years of pipe life. If you'd like to learn more about Mr. Centriline and how he can work for you, just write or call for one of our descriptive brochures.

CENTRILINE CORPORATION

A subsidiary of the Raymond Concrete Pile Company

140 CEDAR STREET
NEW YORK 6, N. Y.
WOrth 2-1429

Branch Offices in Principal Cities of the United States, Canada and Latin America

• CEMENT-MORTAR LINING OF PIPES IN PLACE •

torily. Unlike older electrodes, they are also good over the entire 0-14 pH range at temperatures from 15 to 100 degrees C and offer improved resistance to acids, surface deterioration, aging and alkalis.

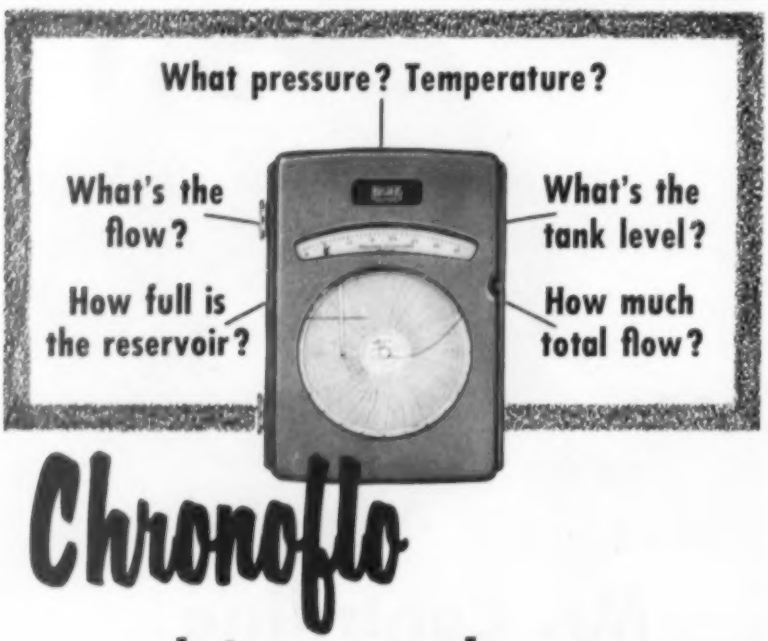
New Trencher For Oliver Tractor

1013

The Oliver Corp., Chicago, Ill., has developed a new all-hydraulic attachment called the Jet Trencher for use with the Oliver OC-3 loader.

The new attachment features a unique 2-point hitch that permits the operator to hook up or remove the trencher in 90 seconds, and without leaving the tractor. With the trencher detached, the 2-point hitch holds the counterweight for front end loader, or takes a number of handy attachments.

The Jet Trencher digs to a depth of 12 feet, lifts to 11½ feet and clears 7½ feet for easy loading of high trucks. Two dipper sticks are available: the longer stick is for digging in moderately heavy soils at depths to 12 feet; the shorter one handles extremely tough conditions, like clay, and digs to 10 feet. Various bucket sizes are available.



Chronoflo

brings you the answers

By transmitting and receiving information over a simple two-wire circuit, Builders Chronoflo TELEMETERS produce important economies for water and sewage plants and industrial process systems.

(1) Chronoflo saves time — gives immediate indications of changes in flow, total flow, pressure, temperature, level.

(2) Chronoflo saves steps — brings information from any point, no matter how far distant to a central control panel for more efficient supervision and system control.

(3) Chronoflo reduces personnel responsibilities — eliminates necessity for on-location supervision of distant pumping stations, storage facilities, reservoirs, standpipes, valve positions, etc. . . . Chronoflo also controls pumps automatically.

(4) Chronoflo is tested and approved — by thousands of installations in all types of water and sewage applications.

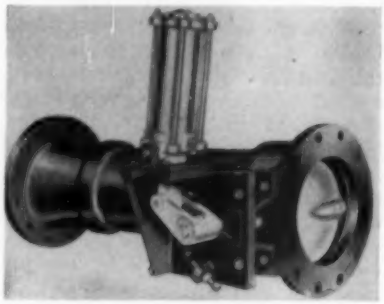
Chronoflo is one of the many Builders metering and controlling systems for modern plant operation. Write for your copy of Bulletin 230-H4 describing Builders Chronoflo Telemeters, or tell us about your own metering and controlling problem. Builders-Providence, Inc., 350 Harris Avenue, Providence 1, Rhode Island.

BUILDERS-PROVIDENCE

DIVISION OF B-I-F INDUSTRIES, INC.

BUILDERS IRON FOUNDRY • PROPORTIONERS, INC. • OMEGA MACHINE CO. BIF METERS FEEDERS CONTROLS

Tight-Closing Rate Of Flow Controller

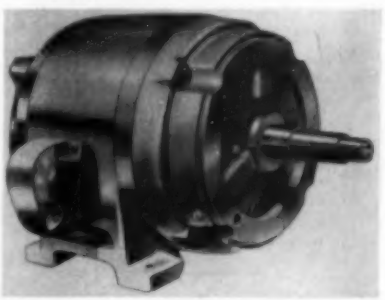


1014

Builders-Providence, Inc., Providence, R. I., has developed an advanced design power-actuated rate of flow controller for the effective operation of water, waste or industrial plants.

The controller comprises a Venturi metering section and a pressure recovery section, a power-actuated valve mechanism, and a pneumatic, hydraulic, or electric positioning control unit. Its cast iron body, for working pressures up to 125 psi, has a pressure-averaging annulus at the inlet and a closed annular chamber with multiple vents at the throat. The bronze lined Venturi throat section is of the proper diameter and contour for maximum accuracy and for insuring freedom from corrosion and tuberculation. The model RCB-T comes equipped with a rubber-seated butterfly valve for tight closure.

Horizontal Close-Coupled Pump Motor



1015

U. S. Electrical Motors Inc., Los Angeles, Calif., has developed a new motor, with a face type registered bracket and special shaft, suitable for close-coupled centrifugal pump applications.

Built to the new re-rated NEMA specifications, the Uniclosed motor is extra compact, with more horsepower in less space. Pump may be mounted

flush with motor by bolting to face bracket. This method of coupling insures accurate alignment of pump and motor.

To prevent water from entering motor, a solid flange and brass slinger are incorporated. Shaft is stepped with special diameters, and has shoulder and tapped hole for mounting the impeller. Shaft diameters are precision ground to very close tolerances for accurate assembly and sealing against leakage. The new motors are available in ratings from 1 to 30 hp.

Pittsburgh Coke Adds Three Products

1016

The Pittsburgh Coke & Chemical Company, Pittsburgh, Pennsylvania, has announced the addition of specialty tars, coal tar pitch and creosote to the products manufactured and sold by its Protective Coatings Division. These materials were formerly handled by the company's Coal Chemical Division.

Mr. N. T. Shideler, Manager of the Protective Coatings Division, said the move will fully integrate the division's position in the production of Pitt Chem Pipeline Enamels and Coal Tar Coatings.

In addition, further emphasis is being placed on Pittsburgh's program of upgrading basic coke oven-derived materials and of developing new products from these materials.

Air Signal Adjusts Capacity Of Controlled Volume Pump

1017

Milton Roy Company, Philadelphia, Pa., has developed a controlled volume pump with instrument air stroke length adjustment for use in pneumatic process control sytsems.

Designed to solve specific low capacity flow control problems, the new pump utilizes a unique air servo system with feedback loop to give capacity adjustment with an accuracy within 1 percent.

Stroke length of the pump is infinitely adjustable from zero to 100 percent of full length by means of a reversible rotary air motor. This motor and other components of the pneumatic servo system are housed in a 22-inch high cabinet mounted on the pump base. Four easy-to-read gages show key air pressures at all times. Actual stroke length is indicated by a dial mounted on the pump.

BIG valve...little space

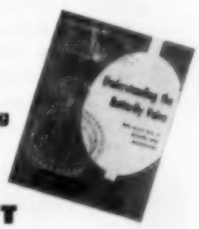
The disc in this 84-in. low pressure Butterfly Valve must withstand 138,000 lbs. of force when closed against a 25 P.S.I. line pressure . . . yet the face to face dimension is only 18 in. and the entire valve weighs just 12,000 lbs. Even under this severe loading Pratt design keeps the bearing pressure well below 2500 P.S.I.

Pratt Rubber Seat Butterfly Valves are manufactured in sizes from 10 in. to 168 in. in diameter, in pressure ratings up to 125 P.S.I. Their low initial cost, easy installation and proven low maintenance make them the logical solution to valving problems, both for new projects and as replacements.

The Henry Pratt Company originated and has been making this type of valve for over 28 years. Our background represents the greatest cumulative experience in the industry. It is the reason why Pratt Valves are so convenient to install, easy to operate and give long years of trouble-free service. **For full details write for Bulletin 1-C.**

HENRY PRATT

Send for informative booklet "Understanding Butterfly Valves."



RUBBER SEAT Butterfly Valves

Henry Pratt Company, 2222 S. Halsted St., Chicago 8, Ill. Representatives in principal cities

W&SW

Manufacturers' News

Edwin Letts Oliver, Noted Engineer, Dies at 77

Edwin Letts Oliver, noted mining engineer and Founder-Chairman of Dorr-Oliver Incorporated, died suddenly at his summer home at Lake Tahoe on August 28, 1955, at the age of 77.

Best known for his work in the field of continuous filtration, Mr. Oliver developed the Oliver Continuous Filter in 1907, the first successful unit of its type.

Widely used today throughout the world in metallurgical, chemical, industrial and sanitary processing, this filter was the cornerstone of the Oliver Continuous Filter Company founded in 1910 by Mr. Oliver to market his invention. Subsequent expansion over the years and the development and acquisition of other related equipment resulted in the formation in 1928 of Oliver United Filters, Inc. Mr. Oliver served as president of this latter company from its inception until December, 1954, when it was merged with The Dorr Company to form the internationally known engineering organization, Dorr-Oliver Incorporated.

In recognition of his pioneering and service to the metallurgical and process industries, Mr. Oliver was the recipient of many honors in the course of his professional career. Notable among these were the James Douglas Medal, most distinguished award of the American Institute of Mining & Metallurgical Engineers, and the degree of L.L.B. conferred upon him by the University of California in 1945.

Get Ready to Grow!

Plan now for

Adequate - Permanent

CAST IRON WATER MAINS

Prospects are good that your community will be welcoming one or more new industries within the next few years. In planning your city's water system, bear in mind that most industries today need water—and plenty of it. Even a fair sized plant will use as much water for product processing, cooling, boiler feed, sanitation and service purposes as an average town of 10,000 people.

Equally important as ADEQUATE water is its DEPENDABLE delivery. That's why only permanent, trouble-free Cast Iron Pipe should be specified. Because of its century or more of useful life, its high capacity as a carrier and negligible maintenance cost, Cast Iron Pipe has earned its reputation as *America's No. 1 Tax Saver.*

* * * * *

Our Company does not manufacture pipe but has long supplied the nation's leading pipe manufacturers with quality iron from which pipe is made.

WOODWARD IRON COMPANY

WOODWARD, ALABAMA

Byron Jackson Merges With Borg-Warner Corp.

Byron Jackson Company, Los Angeles, Calif., has announced that the company has merged with the Borg-Warner Corporation. The merger plan provided that Borg-Warner exchange four shares of its common stock for each five shares of Byron Jackson.

According to Borg-Warner, Byron Jackson will retain its own identity, management and operating policies, and as of September 1, 1955, became the Byron Jackson Division of the Borg-Warner Corporation.

Armco's Quebec Plant To Start Production

Armco Drainage & Metal Products Co., Middletown, Ohio, has announced that production of corrugated metal pipe at the company's newest plant at Charny, Quebec, Canada, will start in October.

Under construction since June, the

Charny plant will manufacture corrugated metal pipe and pipe arch for drainage use. Some will be coated with asphalt for installation where corrosive conditions are especially severe. The new plant will also serve as a warehouse for additional Armco products.

Hersey Appoints New Asst. Sales Manager

The Hersey Manufacturing Company, South Boston, Mass., has announced the appointment of Ralph Estus as Assistant Sales Manager.

Mr. Estus has had years of successful sales experience, having formerly been associated with the Armstrong Cork Co., and until recently with the Fuller Brush Co. of Hartford, Conn., as manager of industrial sales.

Albright & Friel Move Offices

Albright & Friel, Inc., Consulting Engineers, formerly located at 121 South Broad St., Philadelphia, Pa., has announced the removal of their offices to Suite 1500, Three Penn Center Plaza, Philadelphia 2, Pa. The new telephone number is LOcust 8-2345.

Clay Pipe Assn. Moves Offices

The National Clay Pipe Manufacturers Association, Washington, D.C., has announced that their headquarters staff has moved to larger and more adequately equipped quarters.

Mr. D. M. Strickland, president, stated that this move to new offices, located at 1820 N Street, N.W., Washington, D. C., comes at a time when Association activities are expanding manyfold. Larger facilities will enable the Association to continue to increase its services to the public, to better expedite its duties to its members and to accommodate the accelerated program of cooperation with government.

Glover Assumes New Duties At Simplex

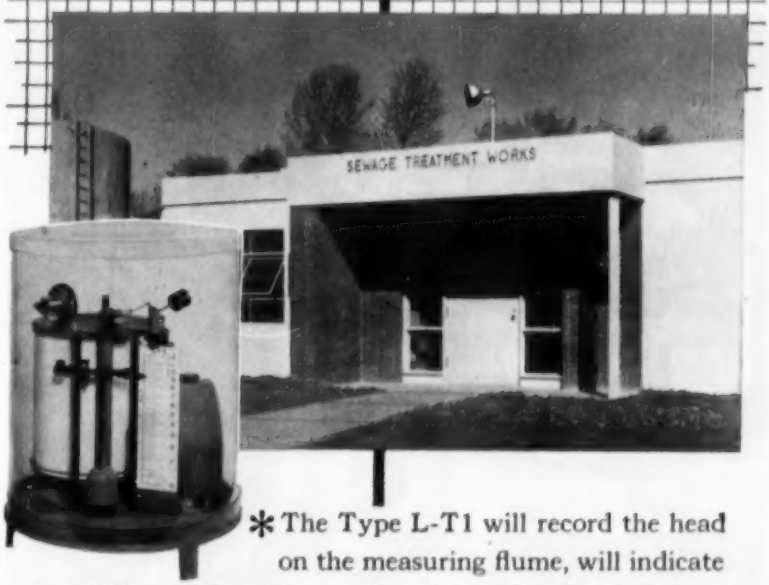
Simplex Valve & Meter Company, Lancaster, Pa., has announced that Wayne W. Glover, in addition to his duties as Chief Engineer, has also assumed the responsibility of Assistant Secretary of the Company.

Glover came to Simplex in June 1924 as blue print boy, was made assistant to chief engineer in January 1931, promoted to assistant chief engineer in May 1938, and appointed

(Continued on page 116A)

PROBLEM:
To obtain at minimum cost the essential information on flow required for efficient operation of a small sewage treatment plant.

SOLUTION:
Stevens Type L-T1 Recorder*



*The Type L-T1 will record the head on the measuring flume, will indicate the volume of flow for any time interval and will give an instantaneous reading of the rate of flow. The head record, made on convenient rectangular coordinates, is basic information for permanent record from which plant operators and State Sanitary Engineers can check flows and volumes. The volume reading from the totalizer dials and the rate of flow indicator are essential for intelligent operation. Readings can be made in any desired volume and flow units.

STEVENS DATA BOOK

...invaluable for your reference file
144 pages of technical data on recorder installations... plus a wealth of hydraulic tables and conversion tables. **Send $1.00 (No C.O.D.'s)**

CONSULT WITH STEVENS INSTRUMENTATION SPECIALISTS

LEUPOLD & STEVENS INSTRUMENTS, INC.
4445 N. E. GLISAN STREET • PORTLAND 13, OREGON
Foremost in Precision Hydraulic Instruments Since 1907

to the position of chief engineer in July 1942.

Glover is a graduate of Drexel Institute of Technology with a degree in Mechanical Engineering. He is a member of the ASME and ISA.

De Laval Pacific Moves To New Building

De Laval Turbine Pacific Co., San Francisco, has announced that the company has moved into their new building at 201 East Millbrae Avenue, Millbrae, on a 2.7 acre site in the Millsdale Park.

Within a month, the De Laval Pacific Co., now located at 61 Beale St., San Francisco, will relocate in this same new Millbrae plant.

De Laval's new industrial building was constructed by Rothschild, Raffin & Weirick, San Francisco General Contractors.

Shop and warehouse are tilt-up construction. This building will house the assembly of De Laval centrifugal pumps, repair and service operations, manufacturing of industrial filters and general warehousing for both De Laval firms.

Infilco Promotes Kominek

Infilco, Inc., Tucson, Ariz., has announced that Edward G. Kominek has been promoted to position of General Sales Manager.

In his new position Mr. Kominek will have general supervision of all sales representatives in the country for Infilco, Inc., as well as for Infilco Canada, Infilco Mexicana, and offices in other foreign countries. He has been assistant sales manager since 1950.

Mr. Kominek has been with the company since 1937 when he joined it as a research chemist with the exception of a brief leave of absence in 1944-45 when he was loaned to the Houdaille-Hershey company to supervise their Atomic Energy plant at Decatur, Illinois.

Fischer & Porter Opens El Paso Office

Fischer & Porter Company, Hatboro, Pa., has established a district sales office at 607 Montana Street, El Paso, Texas.

Charles Allen, formerly a field engineer in the firm's Houston office, has been named district manager.

The El Paso office was established because of the growing industrial importance of the area and because Fischer & Porter complete process instrumentation is finding increasing application in the refining industry, water, sewage and industrial waste plants.

The El Paso sales territory comprises New Mexico and most of Texas west of and including San Angelo.

Jeffrey Opens Office In Raleigh, N. C.

The Jeffrey Manufacturing Co., Columbus, Ohio, has announced the opening of a new district office in Raleigh, North Carolina, under the management of J. R. Brisley. Located at 116 South Harrington St., the office will promote and sell products of Jeffrey's Conveyor Division in North Carolina and a part of Virginia.

Mr. Brisley, a Navy veteran of World War II, is a 1942 graduate

with **CLOW** *mechanical joint*

SPLIT SLEEVES

Don't be caught short this winter without a stock of Mechanical Joint Split Sleeves. Be prepared with sleeves for every size pipe in your system. Clow split sleeves fit all classes of cast iron pipe, and make a fast, simple, permanent repair.

F-1200 Straight Split Sleeves will repair breaks in the barrel of the pipe. F-1205 Bell Split Sleeves will repair damaged joints of underground pipe, as well as the barrel.

Clow Split Sleeves are shipped complete with joint accessories. All sizes 3" through 16" available for immediate shipment.

James B. Clow & Sons Inc.

201-299 N. Talman Avenue, Chicago 80, Illinois

Subsidiaries: Eddy Valve Company • Iowa Valve Company

of Sheffield Scientific School, Yale University. He joined Jeffrey in 1945, transferred to the company's Philadelphia office in 1947 and in 1949 was made manager of the Baltimore office.

B-I-F Adds Two Sales Engineers To Philadelphia

B-I-F Industries, Inc., Providence, R. I., has announced additional Sales Engineers in its Philadelphia office.

Frank J. Mahoney was formerly employed as Senior Chemist and Consultant for the Flint, Mich., Water Works Dept. He holds degrees from Michigan State College and the University of Michigan. James M. Hines has been affiliated with B-I-F Industries for more than twelve years in Huntington, W. Va. He is a graduate of Brown University, Providence.

These representatives will make their headquarters in the Philadelphia office—Alan A. Wood, Inc. —providing that area with additional factory-trained engineers for Builders-Providence, Inc., flow meters and controls; Proportioneers, Inc., chemical proportioning equipment; and Omega Machine Co., liquid and dry chemical feeders.

Foxboro Signs Japanese Associate

Foxboro Company, Foxboro, Mass., has announced that Foxboro instrumentation for Asiatic industries will shortly be available through the Yokogawa Electric Works, Ltd., Tokyo, Japan. The Japanese firm will manufacture and sell the full Foxboro line, as well as its own electrical strip chart instruments.

Foxboro-YEW products will be identical in design, appearance and performance to those manufactured at Foxboro, Mass., and at associated firms in London and Montreal. Industries that operate internationally can thereby select the most convenient point of supply in line with currency availability and delivery considerations.

Universal-U. S. Pipe Elects Officers

Universal Sewer Pipe Corporation and United States Concrete Pipe Company, Cleveland, Ohio,

(Continued on page 118A)

Making tight, dependable joint on Jeffersonville job with Ropax and Kalktite.

TO GET TIGHTER SEWER JOINTS

Jeffersonville, Ind., Specified

ROPAX® packing and cold applied **KALKTITE®** sewer joint compound

To reduce ground water infiltration to a minimum and protect against overloading the sewage disposal plant, Jeffersonville, Ind., needed positively tight, dependable sewer joints in their new 25-mile sewer project.

That is why they chose Ropax and Kalktite, recognized from coast to coast over a 30-year period for producing exceptionally fine results.

Ropax is a non-porous sewer joint packing that provides *additional* joint sealing material. It forms a solid, watertight seal when caulked back in the pipe bell and permits proper pipe alignment. Available in ¾″ to 1¼″ diameters, there is Ropax packing for all sizes of bell and spigot pipe.

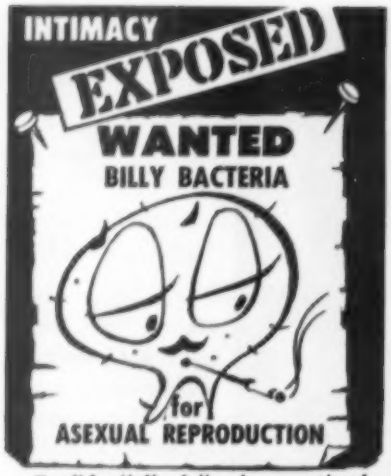
Kalktite is a sewer joint compound that is mixed and applied *cold* on the job. It sets up even under the most adverse pipe laying conditions, forming a dense, tough and flexible seal that allows normal sewer line settlement and alignment deflection. Economical to use, Kalktite allows installation of more joints per man, per hour, per day.

***WRITE TODAY** for samples and new catalog with detailed information on getting better, tighter sewer joints with Ropax and Kalktite.*

PRESSTITE Sealing Compounds

PRESSTITE ENGINEERING COMPANY

3780 Chouteau Ave., St. Louis 10, Mo.



Confidentially folks, by our standards, bacteria have a **poorly balanced** sex life. They have to reproduce through fission.

Pity the bacteria: no sex, no passion, no soul mate, and requiring biochemical and physical nutrition factors over which it has no control. The sex life of bacteria can be briefly summarized as one of impersonal optimism—essentially a food relationship.

Harmonious balance between bacteria and food is the basis of maximum efficiency in sewage treatment; a condition rarely achieved.

BIONETIC* is **FIRST AID TO WASTE TREATMENT** and utilizes various biological mechanisms to effect the improvement of ailing digesters. Flow through rates of trickling filters, after BIONETIC treatment, have been returned to normalcy by removal of grease and sludge and without removing ballast or damaging the zoogleal growths. Hundreds of cities have cleaned their collection systems and lift stations and eliminated odors on the lines and at the plants.

Confidentially, you save money too.

Send for **FREE** informative literature and your **FREE** certificate in the **Loyal Order of Manhole Sniffers.** Mail coupon below:

The Bionetic Division
Reliance Chemicals Corp.
P. O. Box 6724 Houston 5, Texas

____ I want my membership certificate in the LOYAL ORDER OF MANHOLE SNIFFERS. Also please send me FREE copies of the following BIONETIC Tech Talks:

____ Sludge Digestion
____ Cleaning Collection Systems
____ Care of Trickling Filters
____ Odor and Grease Removal

Name_____
Address_____
City and State_____

*Reg. TM: Reliance Chemicals Corp. Applies only to a specific method of manufacture of preserved cultures of beneficial micro-organisms of uniform potency that are field tested in waste treatment plants.

has announced that at a recent meeting of the Board of Directors the companies elected new officers as follows:

Mr. S. O. McFall, Chairman of the Board; Mr. R. F. McFall, President; Mr. R. H. Exley, Executive Vice President and Treasurer; Mr. J. J. Satow, Secretary; and Mr. H. B. Bodenhamer, General Sales Manager.

The two firms which operate under one management specialize in the production of vitrified clay sewer pipe and related articles, and concrete sewer and culvert pipe. The companies' general offices are in Cleveland's Union Commerce Building.

Simplex Moves New York Office

The Simplex Valve and Meter Company, Lancaster, Pa., has announced the establishment of its New York City office at 117 Liberty Street, New York 6.

Sales and services will be supervised, as in the past, by Mr. George L. Walker, district manager. Mr. E. M. Lodge will continue to handle Simplex sales for Central and Northern New Jersey. The New York City office will also schedule and service equipment in the metropolitan area, including Long Island, Connecticut and New Jersey.

Foxboro Appoints Rogers West Coast Manager

The Foxboro Company, Foxboro, Mass., has announced that R. E. Rogers, formerly manager of the Los Angeles branch, has been appointed manager of the company's West Coast sales activities.

Mr. Rogers has headed the Los Angeles office since 1946, formerly serving as industrial engineer at the Tulsa and New York offices. He plans to make his new headquarters at Foxboro's newly completed branch factory in San Leandro, Calif.

Replacing Mr. Rogers as Los Angeles branch manager is E. W. Pitt, who has transferred from the Shreveport, La., office where he has been branch manager since 1948. D. P. Thomas, industrial engineer, has been promoted to branch manager at Shreveport.

Koppers Promotes Weidlein

Koppers Company, Inc., Tar Prod-

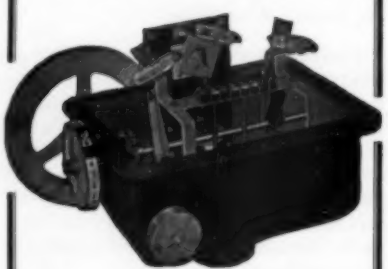
Surer Gland Lubrication for Centrifugal Pumps

THE Z-F GREASE SEAL

Eliminates that trouble spot where shaft enters casing. Applies constant positive lubrication to packing and shaft—automatically. Excessive heat, rapid wear, leakage and scoring will disappear as the Grease Seal applies a constant flow of lubrication when pump starts until it stops—automatically. Many other advantages, too. Write for complete description and price.

ZIMMER and FRANCESCON
MOLINE, ILLINOIS

ROTO-TROL



RF-2

WITH ALTO-TROL

This 2-pump RF-2 Roto-Trol assures equal use and wear of both pumps. Each pump is operated on alternate starting cycles. The RF-2 operates both pumps together, when required. RF-2 installations give dependable service year after year, with the minimum of attention.

Write for full data

WATER LEVEL CONTROLS DIVISION
HEALY-RUFF COMPANY
783 HAMPDEN AVE., ST. PAUL 4, MINN.

ucts Div., Pittsburgh, Pa., has announced that R. B. Weidlein, formerly Training Supervisor in the Industrial Relations Section, has been appointed Administrative Assistant in the Division's Sales Department.

A native of Pittsburgh, Mr. Weidlein joined Koppers in 1949, and had been Personnel Manager at the Follansbee plant before he became Training Supervisor. He was graduated from Princeton University and received an LL.B. degree from the University of Pittsburgh Law School.

Aurora Pump Names Sales Engineers

Aurora Pump Division, Aurora, Ill., has announced two recent additions to its eastern sales force.

Charles S. Quillen has been appointed Sales Engineer in the New Jersey territory. Mr. Quillen was graduated from Drexel Institute of Technology in 1933 and comes to Aurora with a wide background of experience in the pump sales field. He is a member of the American Institute of Chemical Engineers.

Schuyler B. Sterling will represent Aurora's newly established Domestic Water System Department, calling on Eastern jobbers and distributors. Mr. Sterling brings to Aurora a long experience as field engineer and sales representative in the pump field.

The products of the Domestic Water System Department will be distributed from newly expanded facilities in New York City.

Enterprise Engine Appoints Atsatt Chicago Branch Manager

Enterprise Engine and Machinery Company, San Francisco, Calif., has announced that Stuart F. Atsatt has been appointed Manager of the Chicago Branch.

Mr. Atsatt, 6 years with Enterprise, has spent the last two years in Minneapolis as District Manager. Previous to that he was project engineer and home office sales engineer for the company. He is a Stanford University graduate in mechanical engineering, and was an engineering officer in the U. S. Navy during World War II.

Combustion Engineering Promotes Three

Combustion Engineering, Inc., New York, N. Y., has announced the following promotions:

Carmine J. Grossi from Assistant

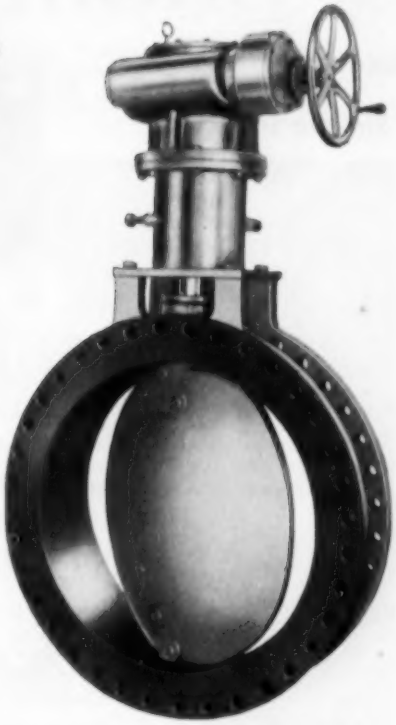
(Continued on page 120-A)

For Flow Control

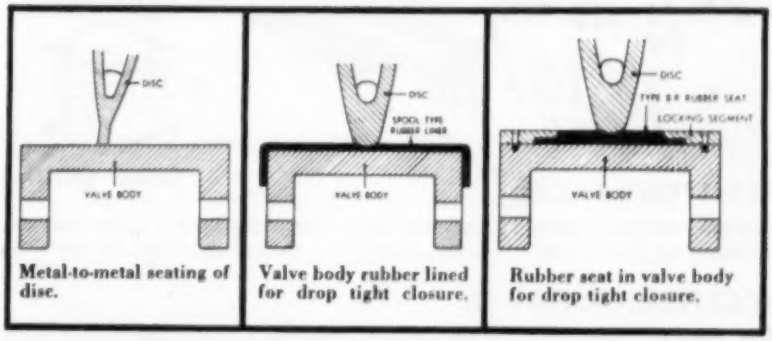
Butterfly Valves

Offer These Advantages

1—Minimum Restriction to Flow
2—Minimum Turbulence
3—Non Clogging—Self-Cleaning
4—Always Easy to Open and Close
5—Manual or Automatic Control
6—Lower Installation Cost
7—Light Weight—Compact
8—Reduced Installation Space
9—Less Maintenance



42"—125# butterfly valve with hard chrome edged disc, stainless steel shaft, bronze bearings and enclosed worm gear, handwheel operator. Valve body lined with rubber for drop tight shut-off at 140 p.s.i. water pressure.



Metal-to-metal seating of disc.

Valve body rubber lined for drop tight closure.

Rubber seat in valve body for drop tight closure.

In W. S. Rockwell Butterfly Valves you have the most completely engineered line for water works, sewage and industrial waste treatment plants. Standard valves are built in sizes to 72" for 25, 50 and 125-lb., in any desired metal, with manual or automatic operators. Larger sizes can be built to specifications. Write for new catalog.

W. S. ROCKWELL COMPANY

ROCKWELL SINCE 1888 BUILT

BUTTERFLY VALVES • SLIDE VALVES • AUTOMATIC VALVES

2825 ELIOT STREET • FAIRFIELD, CONN.

Sales Representatives in Principal Cities

SPARLING

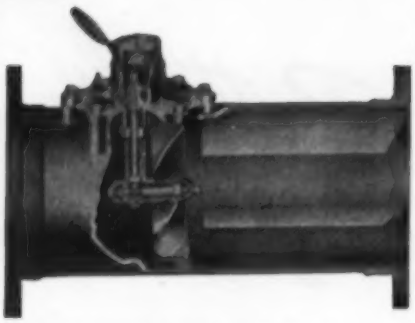
WATER CONTROL EQUIPMENT

Accurate

Simple in Action

Easy to Install

Easy to Maintain



As shown, flow is from right to left; the propeller revolves in direct ratio to velocity of flow, and registers volumetrically in register on meter-head. No further instrumentation necessary for logging a mainline!

RECORDERS . . INDICATORS . . CONTROLS

Instruments and controls can be added at your pleasure and at any distance desired, without disturbing the meter in the line. Here, indeed, is the equipment for Service and Satisfaction!

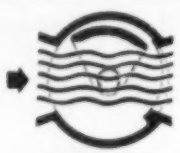
Bulletin 314 and quotations are yours for the asking.

SPARLING METER COMPANY

INCORPORATED

ATLANTA 3 ..... 66 Luckie Street, NW
BOSTON 8 ..... 6 Beacon Street
CHICAGO 8 ..... 1500 South Western Ave.
CINCINNATI 2 ..... 626 Broadway
DALLAS 1 ..... 505 N. Ervay St.
KANSAS CITY 6, MO. ..... 6 E. Eleventh St.
Box 3277 ..... LOS ANGELES 54
101 Park Avenue ..... NEW YORK 17
85 Industrial St. ..... SAN FRANCISCO 24
1932 First Avenue ..... SEATTLE 1
207 Queens Quay West ..... TORONTO, CAN.
248 London Rd. ..... ROMFORD, ENGLAND

the DeZurik Difference is in the Plug!



OPEN FULL

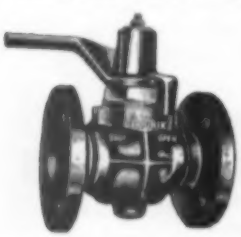
DEAD SHUT

RESILIENT-FACED

The resilient plug-facing of DeZurik Easy-Operating Plug Valves provides a cushioned closure which seals dead tight around particles in the flow.

ECCENTRIC-SHAPED

The matched eccentric surfaces of the plug and seat *wedge* tightly shut. In opening the valve, the first fractional movement of the handle lifts the plug from the seat; a quarter-turn opens the valve easily. There's no sticking, no binding—no lubrication! DeZurik Valves operate with minimum maintenance—despite silt or sludge in the flow.



See us in Booth 83-84 at Atlantic City, or write for complete details.

DeZURIK SHOWER COMPANY

SARTELL, MINNESOTA

General Sales Manager to Manager of the Export Division.

Frank J. Bader, formerly District Manager at San Francisco, to Assistant General Sales Manager in New York.

Herman C. Reichard from the Kansas City Sales Office to District Manager in San Francisco.

S. Morgan Smith Promotes Boigegrain

The S. Morgan Smith Company, York, Pa., has announced the appointment of Joseph H. Boigegrain to the position of Assistant to the Sales Manager, Valve Division. He replaces Russell C. Ayers who has gone into private business.

Prior to his appointment, Mr. Boigegrain was Valve District Manager of the Pacific Territory with offices in Temple City, Calif. Harry A. Doell, S. Morgan Smith Company District Manager for Turbine Sales, will now also be District Manager for Valve Sales. His offices are located at 68 Post St., San Francisco.

Mr. Boigegrain has been associated with the S. Morgan Smith Company since April 1, 1953. He was formerly associated with the Sparling Meter Company and more recently, the Water Works Supply Company.

Toledo Pipe Promotes Hartsing

The Toledo Pipe Threading Machine Co., Toledo, Ohio, has announced the appointment of C. E. Hartsing as Manager of Field Sales.

A member of Toledo's sales staff for many years, he served as the firm's Western Sales Manager prior to his present appointment. In his new post he will be in charge of Toledo's enlarged sales force of 21 salesmen covering the United States and Canada.

Although he will devote a considerable part of his time working with Toledo salesmen in the field, he will reside in Toledo, Ohio. He can be contacted through the office at 1445 Summit Street, Toledo 4, Ohio.

Lovins Joins Photovolt

Photovolt Corporation, New York, N. Y., has announced that Mr. Gerald H. Lovins, formerly of Silver Spring, Md., has joined their staff.

Mr. Lovins holds degrees in chemistry as well as electrical engineering and has had over 21 years' experience in the laboratory instrument field. He will devote most of his time to the development of new products.

Literature & Catalogs

T-Lock Amer-Plate Sewer Lining

1018

Amercoat Corporation, South Gate, Calif., has just published a new brochure describing **T-Lock Amer-Plate**, the continuous plastic sewer lining. The sewer lining is a high polymer vinyl resin sheet which is permanently impervious to hydrogen sulphide and other sewer gases, acids, alkalis and salts. The brochure describes in detail the application of T-Lock Amer-Plate to the interior of both pre-cast and cast-in-place pipes and structures.

The brochure contains 16 photographs illustrating major sewer projects where over two million square feet of T-Lock Amer-Plate are now in use — some of it for seven years, without deterioration. Complete information is included on the composition, physical and chemical properties, and the method of incorporation of the lining in various types of sewerage construction.

The name "T-Lock" is derived from the unique T-shaped ribs which project from the back of the sheet. When the concrete is poured, it completely surrounds the T's, mechanically locking the lining to the wall of the sewer.

Because increased costs of original construction and replacement of sewers today make the use of a permanent corrosion resistant sewer lining more important than ever, this is the most likely reason for the increasing acceptance of T-Lock by consulting and municipal engineers.

New Movie On Bacteriological Water Analysis Using Membrane Filters

1019

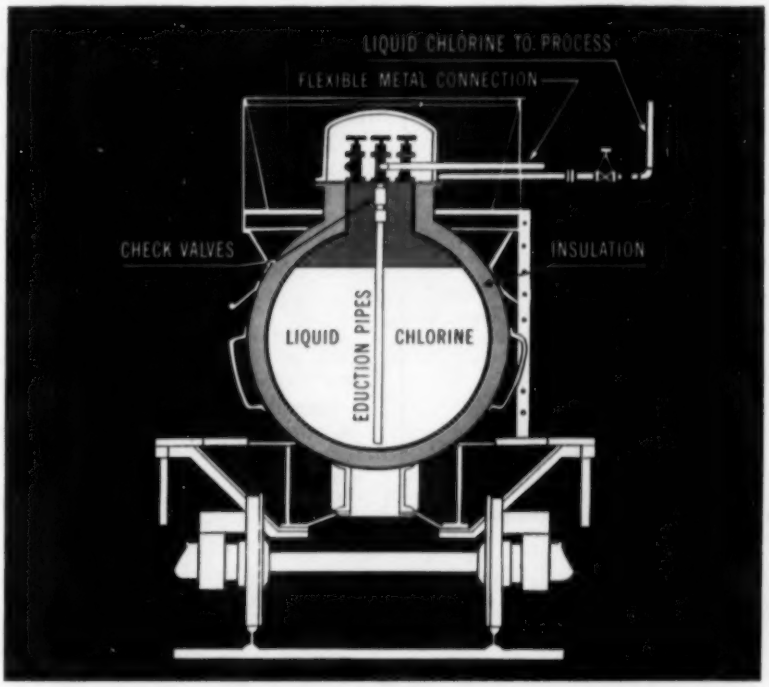
Millipore Filter Corp., Watertown, Mass., has available a new 20-minute, 16 mm sound and color motion picture that illustrates and describes the advanced techniques in bacteriological water analysis using the **Millipore Membrane Filter.**

The film entitled "A New Standard of Precision in Microfiltration

(Continued on page 122A)

Chemicals you live by

Diamond Chlorine



HERE'S ANOTHER WAY WE LOOK AT CHLORINE . . .

This drawing from the DIAMOND ALKALI Chlorine Handbook—illustrates another way we look at chlorine: as a product that should be handled with maximum safety and efficiency.

As one of America's largest producers, shipping from four strategically located plants, we have accumulated a wealth of chlorine knowledge—money-saving information and safety know-how FREELY available to you. For prompt shipment or service, call your nearby DIAMOND Sales Office or write DIAMOND ALKALI COMPANY, 300 Union Commerce Building, Cleveland 14, Ohio.

DIAMOND ALKALI CHEMICALS®

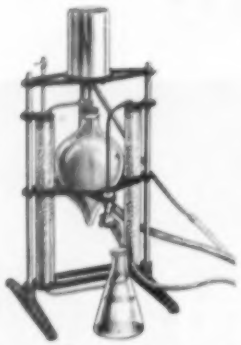
Diamond Chemicals

CHLORINE PLANTS: Edgewood, Md. — Muscle Shoals, Ala. — Painesville, Ohio — Houston, Texas.

SALES OFFICES: New York, Boston, Philadelphia, Pittsburgh, Cleveland, Cincinnati, Chicago, St. Louis, Memphis, and Houston.

ENSLOW

STABILITY INDICATOR



For checking the equilibrium of a finished water, and supplying an index useful in controlling anti-corrosion treatment. Catalog No. 83-895

WRITE:

Phipps & Bird, Inc.

P. O. Box 2V Richmond 5, Va.

and Research" presents a factual report on the accuracy, efficiency and relative simplicity of this method of water analysis, which is discussed in the tenth edition of "Standard Methods for the Examination of Water, Sewage and Industrial Wastes." Striking close-ups in full color point up the salient features of this filter medium.

Other applications of the filter, including use in monitoring of radioactive dust and other hazardous airborne materials are featured in this motion picture, which was prepared in cooperation with a number of leading technical authorities.

The film is available for showing to public health officials and interested scientific groups.

Main Line Metering

1020

Builders-Providence, Inc., Providence, R. I., has printed a four-page color bulletin telling of the large savings in power realized through the utilization of a **Venturi Insert Nozzle** designed for metering liquid, steam, air, or gas.

The bulletin tells how the smooth, stream-lined contour of the inlet, the specially-lined throat with annual rchamber and multiple vents, together with the special outlet cone obtain high pressure-head recovery and long retention of initial accuracy. Other advantages in-

useful reference manual, FREE!

Tells how to use pH and chlorine control for efficient coagulation, algae control water softening, waste treatment, etc.

100 pages of factual detail on theory and application of pH and chlorine control. Useful every day. Clearly written, concise, easy-to-read. Data based on 25 years service to industry. Also illustrates and describes complete line of Taylor Comparators, tells how to use Taylor equipment in your plant.

1930 1955 SERVING SCIENCE AND INDUSTRY FOR 25 YEARS

WRITE FOR YOUR FREE COPY TODAY!

W. A. TAYLOR AND CO.
7308 YORK RD • BALTIMORE 4, MD

the search for PURE WATER

354 B.C.

"Hippocrates' sleeve" (a cloth straining bag) was a popular water treatment method in the 4th Century B.C.

For excellence in MODERN water treatment equipment —gravity and pressure filters—recirculation apparatus...

MECHANICAL EQUIPMENT BY ROBERTS FILTER MFG. CO. DARBY, PENNA.

ROBERTS FILTER MANUFACTURING CO.
607 COLUMBIA AVE., DARBY, PA.

POSITION AVAILABLE

Los Alamos requires a chemist with good foundation in bacteriology to supervise laboratory section of research and development group working on methods of treatment of radioactive wastes as well as operation of small waste treatment plants. Must have B.S. in Chemistry, advanced degree preferred, and a minimum of 10 years experience in field of waste treatment. Salary is $600 to $700 range dependent on education and experience. Pleasant working conditions in delightful high, dry climate. Liberal benefits include generous annual and sick leave time and excellent retirement plan. Write Attn: John A. Stevenson.

LOS ALAMOS SCIENTIFIC LABORATORY OF THE UNIVERSITY OF CALIFORNIA

Los Alamos, New Mexico

ATLANTIC CITY'S NEWEST CONVENTION HOTEL

The Jefferson with its new facilities for handling all convention groups is fast becoming Atlantic City's most popular convention hotel.

The Jefferson features an abundance of Meeting, Banquet and Exhibition Rooms fully equipped to handle your every need. Experienced personnel. Location ideal in heart of Atlantic City.

WRITE • PHONE • WIRE TODAY FOR DESCRIPTIVE LITERATURE

Convention Manager
Hotel Jefferson
Atlantic City, N. J.

clude low head loss; easy installation due to self-contained metering taps (no drilling, taping, etc. required); minimum maintenance due to simplicity of construction and unobstructed flow path; and available pressures limited only by main pipe line as a result of insert design.

Answers to capacity problems are found in the capacity table while sections on the accuracy, installation and dimensions are also included.

Masonry Blades

1021

The Carborundum Company, Niagara Falls, N. Y., has just released a 4-page, color bulletin describing **Niagara Masonry Blades.**

The bulletin covers blade types and sizes, applications, a comparative grade chart, a description of the blade identification system and ordering information.

Continuous Volumetric Feeding Of Fluoride Compounds

1022

Omega Machine Co., Providence, R. I., has just issued a four-page color bulletin on **Accurate and Continuous Volumetric Feeding of Fluoride Compounds.**

In addition to information describing the unit and its operation, the bulletin goes on to tell of the advantages or solutions offered: large hopper; low height and dust-free filling; uniform and visible feed; positive hopper agitator; and low power usage.

According to the bulletin a valuable addition to this volumetric feeder is in Omega Loss-In-Weight Indicator-Recorder a compact low-friction mechanical instrument for indicating and recording rate of feed as well as providing a permanent record of feeder operation. It also indicates continuously the weight of material in the hopper.

Automatic Flow Responsive Water Treatment

1023

Proportioneers, Inc., Providence, R. I., has just issued a color bulletin describing automatic and proportional **Flow Responsive Water**

(Continued on page 124A)

Self-Scouring!
SIMPLEX PARABOLIC FLUME
Measures open flows within ±2%
...over full 20 to 1 range!
• SEWAGE • PLANT WASTES
• WATER • CHEMICALS

Simplex Type S Parabolic Flume saves you the high costs of building a concrete structure to close tolerances, changing piping to make a special approach section.

It's easy to install! Levelling pins assure proper grade. Flanged, bell or spigot inlets are in 6" to 36" standard pipe sizes.

Type S Flume is used alone to indicate flow; with meter to record and totalize.

Smooth transition from circular main to parabolic form speeds flow, keeps flat invert clear! Throw of lever gives quick back-flushing. Big chamber traps sediment, keeps piezometer hole clean!

WRITE FOR BULLETIN 800
SIMPLEX VALVE & METER COMPANY, DEPT. WS-10
7 EAST ORANGE STREET, LANCASTER, PA.

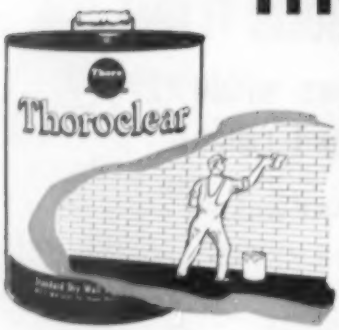
Accurate instruments and controls since 1904

SIMPLEX®
VALVE AND METER COMPANY

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

The THORO System of Masonry Protection

THOROCLEAR



Invisible Water Repellent

Ask your dealer about this powerful silicone water repellent developed by years of research by General Electric Company and now produced by us for your protection. *Ask for Circulars No. 30 and 31.*

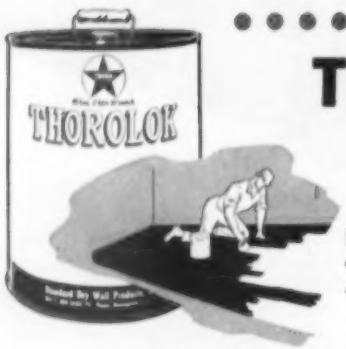
No change in color or texture of brick, limestone, sandstone, tile or stucco surfaces. Applied by brush or spray.

Keep water out of your masonry walls and protect interior plaster, paints and expensive furnishings.

THORITE

20 Minute Set Patching Compound

Repair those broken sills, steps, concrete floors, chimneys and other defective masonry! *Ask for circular No. 20.*



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Comparison Of Filtration Practices

1024

Graver Water Conditioning Co., New York, N. Y., has available a reprint on **Modern Filtration Practices** that provides a comparison between diatomite and sand filtration practices for swimming pool purification.

This article presents, in tabular form, the superior features of both types of filters under such categories as initial investment, operating cost, water quality, supervision and maintenance. There is also a graphic comparison of the size and number of each type of filter required for many different pool sizes and the accessories needed.

Pneumatic Sewage Ejectors

1025

The Blackburn-Smith Mfg. Co., Hoboken, N. J., has just issued a revised catalog on the **Blackburn-Smith Pneumatic Sewage Ejector System.**

Included in the catalog are photographs, graphs, dimension diagrams, and operation data covering the various types of ejectors made by the company, including single and duplex units, and the new all-steel design.

Air Release Valves

1026

Simplex Valve & Meter Company, Lancaster, Pa., has just published a colorful 8-page bulletin describing their **Automatic Air Release Valve.**

According to the bulletin, this valve has the properties of providing a small unit having the functions of releasing automatically air accumulations from systems and pipe lines operating under pressure.

Listed in the bulletin is information on essential requirements, methods of installation, operation, construction, uses, weights, and dimensions.

Rate of Flow Controller For Filter Effluent

1027

The Foxboro Company, Foxboro, Mass., has available an engineering data sheet on **Filtration Rate Control With The Magnetic Flow Meter.**

According to the data sheet, the new meter requires no restriction in the line, no pressure taps and no straight runs. Used in filter control, it consists of a transmitter, a flow recorder-controller located in the operating gallery, and a pneumatically operated butterfly valve controlling the effluent.

The bulletin states that the effluent passing through the transmitter pipe generates a millivoltage directly proportional to the flow. Picked up by two electrodes in the pipe, this signal is recorded directly as volume flow, with deviations corrected by the controller.

AC Operated pH Indicator

1028

Leeds & Northrup Company, Philadelphia, Pa., has available a data sheet on **L&N pH Indicator for Stabilized AC Operation.** This data sheet fully describes how the indicator is being used for pH and redox work, Karl Fischer titrations, and other dead-stop and end-point measurements in both laboratory and plant.

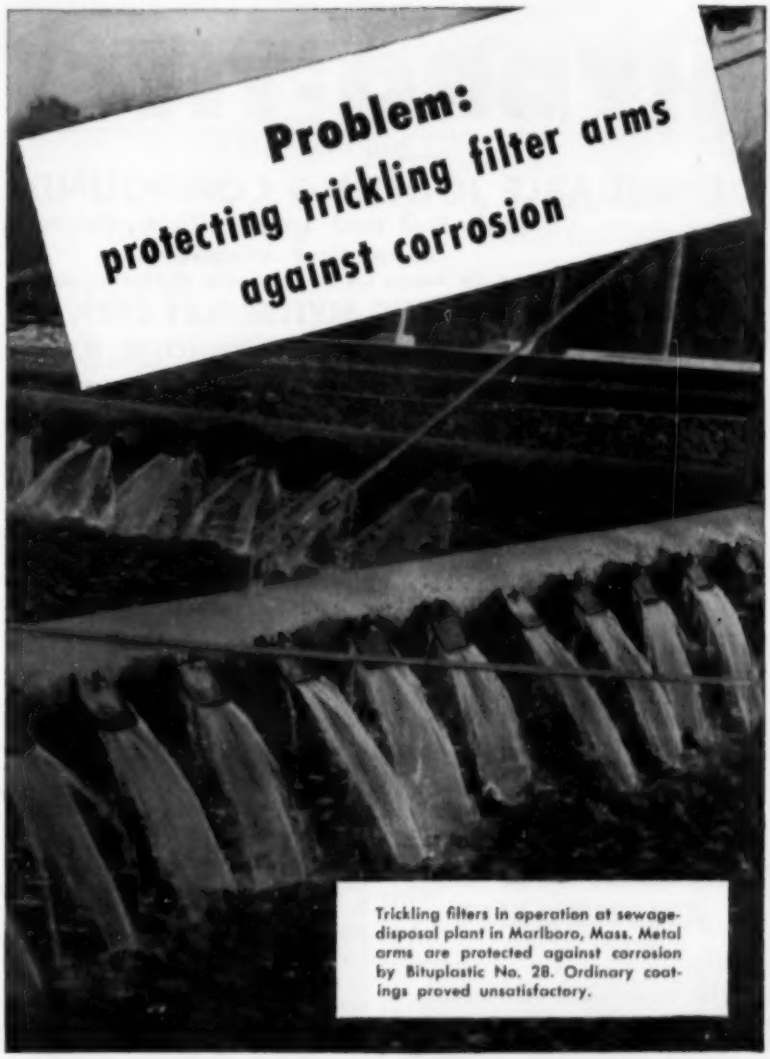
All pertinent data on the indicator are listed in the data sheet. Large photographs and circuit diagram illustrate instrument design and operating features. Complete specifications for the instrument as well as for the required accessories are conveniently arranged in tables. "How to order" instructions complete the sheet.

Permutit Precipitator

1029

The Permutit Company, New York, N. Y., has just published a well illustrated and documented 20-page bulletin, describing the

(Continued on page 126A)



Trickling filters in operation at sewage-disposal plant in Marlboro, Mass. Metal arms are protected against corrosion by Bituplastic No. 28. Ordinary coatings proved unsatisfactory.

• The Marlboro Sewage Department had an annoying problem. When conventional coatings were used, metal arms on trickling filters corroded quickly—so quickly that maintenance was a seemingly endless chore.

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many advantages, recommendations, flow diagrams, and specifications of the **Permutit Precipitator.**

According to the bulletin, the Precipitator offers, through its three basic designs, an efficient means of removing impurities from a liquid by precipitation, absorption, settling, and filtration.

Weir Tank And Flow Splitter

1030

Omega Machine Co., Providence, R. I., has just issued a bulletin showing how its **Proportioning Weir Tank and Flow Splitter,** for dividing the flow of a solution or a suspension to two points of application, provides substantial savings in installation costs and valuable plant space when supplemented by a single chemical feeder.

The bulletin discusses how the operating principle of the weir tank is that the discharge through the rectangular weir varies directly with the length of the weir crest, while the flow splitter divides the total length of the weir crest into two parts. A simple manual adjustment on the flow splitter provides a 10 to 1 range in flow distribution.

In addition to descriptive information on the prescription, operation and control systems possible, the bulletin contains diagrams.

(Continued on page 129A)

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Mechanical Joint Pipe And Fittings

1031

Warren Foundry & Pipe Corporation, New York, N. Y., has just published a new 32-page booklet describing **Warren-Spun Mechanical Joint Pipe and Fittings.**

The booklet provides the detailed method of installation, standard dimensions, thicknesses and weights and a table of standard sizes, classes, thicknesses and weights of Warren-Spun mechanical joint pipe available from the company's Everett, Massachusetts, plant.

Strip-Chart Recorders

1032

The Bristol Company, Waterbury, Conn., has just published a new bulletin describing the company's line of 6-inch **Strip-Chart Recorders** for pressure, liquid level, temperature, flow, and mechanical motion.

The 12-page, two-color bulletin contains installation drawings showing methods of applying the instruments to the different variables, as well as photographs of the various models and their features. The use of the recorder as a receiver for remotely generated signals, either pneumatic or electrical, is also described.

Small Pneumatic Control For Flow or Pressure

1033

Builders-Providence, Inc., Providence, R. I., has just released a 6-page supplementary bulletin describing the **Balancel Pilot Valve Control Unit.**

The unit, which comprises four basic sub-assemblies, weighs only 15 lbs., is 16 by 3 inches long, is used for flow and pressure control in water filtration and waste treatment plants.

The bulletin contains dimensions and installation and schematic diagrams in addition to useful information on the description, operation, and advantages of the unit: these include no friction, lost motion, or wear due to its unique construction which employs no bearings, stuffing boxes, leavers, fulcrums, or knife-edges; fail-safe operation to close the main flow valve if air supply fails; non-jamming pilot valve to pass grit and foreign matter; and low cost, which results from compact design.

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W&T Chlorinators with chlorine evaporators and master control panel (insert) used at the D.C. Sewage Treatment Plant.

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